ICHTHYOLOGICAL ECOREGIONS OF ARGENTINA(*)

Hugo L. López[1,2], **Cecilia C. Morgan**[1] **& Marcelo J. Montenegro**[1]

[1] División Zoología Vertebrados, Museo de La Plata, Paseo del Bosque s/nº, 1900 La Plata, Argentina. ProBiota.
[2] Comisión de Investigaciones Científicas de la Provincia de Buenos Aires (CIC).
[3] Instituto de Limnología "Dr. Raúl A. Ringuelet" (ILPLA), CONICET-UNLP.

INTRODUCTION

The Argentine Republic is situated in the southernmost portion of the American continent, occupying over 2,785,600 km^2 not including the Antarctic territory. The country ranges from subtropical areas (21º46'S) to subantarctic regions (55º03'S), extending latitudinally over about 4,000 km. It possesses significant latitudinal and altitudinal variation (33º of latitudinal range, and heights from Bajo de San Julián in Santa Cruz province at 105 m below sea level, up to Mt. Aconcagua, 6,959 m over sea level), as well as two gradients of physical variability, extending in north-south and east-west directions. Owing to these features, the country presents a wide range of climates and soil types, being one of the countries with greatest diversity of biogeographical units (Lean *et al.*, 1990, **In:** Bertonatti & Corcuera, 2000).

There are four main hydrographic systems: Río de la Plata basin, the Atlantic and Pacific drainages, and several endorrheic systems. Within these basins, the ichthyofaunistic assemblage is well represented, with different magnitude in accordance with the different taxonomic groupings and regions considered.

From an ichthyogeographic standpoint, and according to the works of Ringuelet (1975) and Arratia *et al.* (1983), Argentina is included in the Brasilic and Austral Subregions. The first of these is represented by two domains: the Andean Domain, comprising the southernmost portion of Titicaca Province, and the Paranensean Domain, including part of Alto Paraná and Paranoplatensean Provinces. The Austral Subregion is represented in Argentina by the Subandean-Cuyan and Patagonian Provinces.

The present survey indicates that there are about 441 fish species in Argentina, distributed throughout the country; this number represents less than 10% of the total fish species occurring in the Neotropical Region. There is a recognizable trend of faunal impoverishment, both in North-South and East-West direction, reaching its maximum expression in the provinces of Tierra del Fuego (situated at approximately 52º30'S to 55ºS, and 65ºS to 68º50'W) and San Juan (approximately 28º50'S and 67ºW to 70º45'W), which have 4 and 5 fish species respectively. In north-south direction, one of the regional indicators of this phenomenon is the Salado river basin in Buenos Aires province, which constitutes the southern distributional boundary for the majority of the paranoplatensean ichthyofauna; 12 of the families occurring in the Paraná-Plata system are absent from this pauperized paranensean ichthyofaunal assemblage.

Most of the continental fish fauna of Argentina belongs to the primary division of Myers (1949), while some elements are included in the secondary division and others in an amphibiotic or 'marine penetration' category. This ichthyofaunistic scope encompasses a wide range of morphological, biological, ecological and ethological types (benthic and

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. e-mail: hlopez@museo.fcnym.unlp.edu.ar

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pelagic, migrating and sedentary, haematophagous or parasites, annual species, inhabitants of plains or heights, estivation-adapted, etc.) inhabiting different regions within the national territory.

MATERIALS AND METHODS

In this work we have adopted the ichthyogeographic proposals of Ringuelet (1975) and Arratia *et al.* (1983), which in general terms are coincidental with the Argentinian geographical regions, and the hydrographical scheme of Mazza (1961), excluding from our study the Pacific drainage basins. In addition to these, we referred to the works of Menni *et al.* (1996), Arratia (1997) and Dyer (2000). For background on the ichthyofaunistic composition of Argentina we considered López *et al*, (1987), and we consulted various sources such as Ringuelet *et al.* (1967), the bibliographical references in López *et al.* (1981, 1982, 1987, 1989, 1991, 1993, 1994) and Ferriz *et al.* (1998), as well as Malabarba *et al.* (1998) and various regional and reviewing works that are mentioned in Additional Bibliography.

With respect to environmental protection and conservation, we considered the works of Chébez (1994), Bello and Úbeda (1998), Pascual *et al.* (1998), Bertonatti and Corcuera (2000) and López (2001).

For the delineation of the ecoregions (figure 1) we performed a similarity analysis of the previously delineated hydrographical basins, using all the documented records of fish species as characters (Table 1). Table 2 shows the fish families present in each basin as well as their total number. The exotic fish species present in Argentina (Table 3) were not included in the analysis, and neither were some native species which have been spread by anthropogenic action (namely, *Odontesthes bonariensis*, *Jenynsia multidentata* and *Cnesterodon decemmaculatus*). The records that appeared doubtful as to the identification of the species or localities were also dismissed. The similarity analysis was performed applying Jaccard association coefficient and UPGMA clustering with NT-SYS program to obtain the resulting phenogram. The outcome of this analysis, along with other considered elements such as distinctive features of the systems' dynamics, ecological determinants, and processes of environmental degradation occurring in each of the considered areas, were the basic elements used in the delineation of ecoregions.

In the discussion of each ecoregion we have included the number of fish species for each basin, and the percentage that each represents in the total 441 species considered for the analysis (Table 1) is indicated in parentheses.

In the last part of the characterization of each ecoregion we indicate the corresponding category in the classification of wetlands of Argentina (Canevari *et al.*, 1998), the ecoregions of Argentina as delineated by Burkart *et al.* (1999) and the zoogeographical regions of Ringuelet (1961). In the cases where we have tentatively extended the ecoregions into neighboring countries, the description of the ecoregion and all numerical data (including surface area) correspond exclusively to the Argentinian portion.

With respect to the bibliographical references, we have listed separately the works mentioned within the text from the additional bibliography.

RESULTS

1) MISIONERAN ECOREGION

Limits

The ecoregion is limited to the N by Iguazú river; to the W by Paraná river; to the E, by Uruguay river; to the SE it abuts on Lower Uruguay River ecoregion; to the SW, by the courses of two creeks, Itaembé creek (tributary of Paraná river) and Chimiray creek (tributary of Uruguay river), both included in this ecoregion, and by means of an imaginary line running between their headwaters.

We have extended tentatively this ecoregion outside Argentinian territory to encompass neighboring areas in Brazil and Paraguay which are drained by tributaries of Paraná and

Uruguay rivers.

Description

According to Popolizio (1972) it's a plateau with "subhorizontal tabuliform structure", with a dorsal ridge formed by the orographic systems of San José, del Imán or Itacuara and the Misiones sierras. The fluvial system arises from this mountainous ridge and its spurs, and the streams descend on either side of the mountains to flow into Paraná and Iguazú rivers (western slope) and Uruguay river (eastern slope). These courses present many waterfalls originated in by basaltic rock exposures, and among these, the outstanding Iguazú Falls, falling in an arc of approximately 2,700 m of which 2,100 are within Argentina and 600 m correspond to Brazil.

Surface area: 29,801 km^2 (all of Misiones province)

Main basins: rivers Iguazú, Paraná and Uruguay, which form the natural boundaries of Misiones province, along with an important interior hydrographic network; some streams belonging to the Paraná river basin are Uruguaí or Marambas, Piray-Guazú, Cuñapirú, and Yabebyrí creeks, and some from Uruguay basin are Pepirí-Guazú and Yaboty rivers, and Persiguero and Chimiray creeks.

Terrestrial habitats

The rainforest's floristic richness goes unparalleled in Argentina. The contrast between the greens of the forest and the remarkable reddish lateritic soils is the main feature of Misioneran landscapes.

Freshwater habitats

Alto Paraná river: in this sector of its course, the flood plains have scarce to moderate development, and they are under the influence of the dams Yacyretá (in Argentina) and Itaipú (in Brazil). The margins accumulate deposits of sandy sediments, loose and little cemented (on the right-hand or western margin) or gravel and sandstone deposits (left-hand or eastern margin).
Uruguay river: this river is the easternmost in the Río de la Plata basin. It extends along 1,850 km and drains an estimated area of 365,000 km^2. It will be described in the Lower Uruguay River ecoregion.
Iguazú river: its course runs in overall E-W direction and is 1,320 km long. It's one of the longest tributaries to Paraná river within Brazilian territory; the Iguazú or Santa María Falls are situated 28 km upstream from its mouth.

Biodiversity

Alto Paraná river: 217 spp (49.2%)
Tributaries of Paraná river in Misiones: 62 spp (14,1%)
Iguazú river: 45 spp (10.2%)
Uruguay river: no precise data for the main course in this ecoregion
Tributaries of Uruguay river in Misiones: 15 spp (3.4%)
Occuring families: Table 2

This ecoregion comprises the Argentinian portion of Alto Paraná Province (Ringuelet, 1975), with endemic species such as *Oligosarcus menezezi*, *Bryconamericus sylvicola*, *Astyanax ojiara, Bryconamericus agna*, *Gymnogeophagus che, "Cichlasoma" tembe, Pimelodus absconditus* and *P. mysteriosus* as well as other endemic species that occur in the Brazilian sector of Iguazú river and haven't yet been recorded for Argentina (Table 5).

Ichthyofaunistic remarks

The absence of certain groups which are of common occurrence in the Paraná basin (i.e., Miliobatiformes, Clupeiformes, Pleuronectiformes, and some Characiformes and Siluriformes such as *Piaractus, Brycon, Serrasalmus, Paulicea, Pseudoplatystoma*, etc.) in the interior water courses of this ecoregion seems to indicate that certain features of these courses, such as the presence of waterfalls of diverse magnitude, represent a

natural barrier to the distribution of fishes and have fostered the existence of endemisms such as those mentioned above.

Vulnerable species: ornamental fishes collected for commercial purposes (aquarism) as well as those species used as live bait. There in no legal regulation or any type of control respecting these activities.

Biological value

The outstanding feature is the riparian forest which grows along river courses forming a strip of varying width; this biological formation presents a marked reduction of species richness in a general downstream direction.

This ecoregion includes at least six areas considered as "areas of outstanding biodiversity" according to the criteria of Fundación Vida Silvestre Argentina (Bertonatti & Corcuera, 2000).

Impacts/Threats

Modification of water courses, dams and hydraulic activities, habitat fragmentation, poaching, inadequate management and destruction of the natural vegetation of the basin.

This is an area of high anthropogenic impact due to the influence of the dams, both active and projected. Exotic species such as *Cyprinus carpio* (Table 3), the possible spread of *Plagioscion squamosissimus* which has been introduced in Itaipú impoundment, and the presence of species of *Tilapia* in some interior watercourses in Misiones (R. Filiberto, pers. comm.) represent yet another threat to the natural aquatic communities.

National Protected Areas

Iguazú National Park.
San Antonio Strict Natural Reservation

Ramsar Sites

None

Correspondence

Wetlands: Region 1 (Río de la Plata basin), in part.

Ecoregions: Paranense

Zoogeography: Subtropical Domain (Misioneran District)

Rationale

The elements that validate the proposal of this ecoregion are the following:

- This is one of the areas with higher number of ichthyofaunistic endemisms in Argentina (Table 6); a great proportion of these occur in the interior watercourses of the territory.
- Absence in these smaller watercourses of some families which are common in the large rivers (Paraná and Paraguay)
- Anthropogenic influence, manifested mainly as deforestation, agricultural practices and impoundments. An example of this last factor is the great mortality of fishes that has occurred repeatedly in Yacyretá due to "bubble disease" (Domitrovic *et al.,* 1994; Bechara *et al.*, 1996).

Relevant Bibliography

López (1992); Lucena & Kullander (1992); COMIP (1994); Sevori & de Moura Cordeiro

(1994); Azpelicueta (1995); Casciotta *et al.* (1995); Gómez & Chébez (1996); Miquelarena & Protogino (1996); Garavello *et al.* (1997); Miquelarena *et al.* (1997); Rolón & Chebez (1998); Braga (1999); Roa & Permigeant (1999); Azpelicueta & García (2000); Casciotta (2000); Miquelarena & Bockman (2000); Miquelarena & Fernández (2000); Azpelicueta & Almirón (2001); Blanco & Parera (2001); Oldani *et al.* (2001); Giraudo *et al.* (En prensa).

2) SUBTROPICAL POTAMIC AXIS ECOREGION

Limits

To the N with Paraguay (tentatively, it would also encompass neighboring areas of the Paraguay river basin - see figure 1) and with the **Misioneran ecoregion**; to the W, with the **Eastern Paranoplatensean ecoregion** by an imaginary line that falls approximately over the 61ºW meridian, excluding the area of marshes in western Chaco province (see figure 1), and encompassing all the tributaries of Paraná river, including the middle and lower course of Carcarañá river, as well as diverse water courses that flow directly into Río de la Plata; to the E, with **Lower Uruguay River ecoregion**; to the SW with **Salado-Vallimanca ecoregion** and to the SE with the maritime front.

Description

This ecoregion includes the area drained by the lower third of the course of Pilcomayo river, the lower course of Paraguay river and the entire Bermejo river basin, the area of sloughs and marshes in Chaco, Formosa and Santa Fe provinces, the Riachuelo basin and Iberá system in Corrientes province, the Corrientes river basin, the area of Submeridional Lowlands and the alluvial plains of Middle and Lower Paraná river, the Paraná Delta and the Río de la Plata river up to its limit with the maritime front.

Surface area: approximately 375,700 km^2.

Main basins: Besides the mentioned watercourses, the diverse wetlands, which comprise rivers, creeks and slow-draining water bodies that form marshes and sloughs, are of great magnitude and hydrological complexity; the precipitations and regional floods, arising mainly in the Paraná and Paraguay systems but also in Bermejo and Pilcomayo rivers, also contribute their waters to these lentic water bodies.

The zone of Submeridional Lowlands is situated between the provinces of Chaco and Santa Fe, in a vast land depression subject to annual flooding pulses generated by local precipitations and waters contributed from peripheral areas; this area has a poorly defined hydrographical network comprising for the most part shallow lagoons. It has two sectors: the Northern sector features ravines and marshes, while the Southern one is dominated by the salinization processes derived from the high saline concentrations present in both surface and phreatic waters. A system of lagoons that drain largely into the Salado del Norte river through small watercourses lie across the eastern edge of the area.

The Delta is the tide-free sector of Paraná river. It receives numerous tributaries, such as rivers Luján, Sarmiento and Carapachay and smaller watercourses.

Terrestrial Habitats

Part of this ecoregion belongs to the 'Chaco Oriental' (Cabrera & Willink 1971), which also receives the name of 'Chaco de esteros, cañadas y selvas de ribera' because of the abundance of wetlands.

The main landscape includes savannahs of tall grasses, palm-tree forests, marshes and sloughs, broken by small hardwood 'islands' in more elevated areas. This landscape is the result of processes of fluvial and fluvio-lacustrian modeling.

In the Deltaic area the growth of the vegetation depends on the wetlands, and an impoverished prolongation of the Paranensean Rainforest known as Riparian Forest ('Selva Marginal del Plata') reaches the locality of Punta Lara in Buenos Aires province. Within the delta the dominating formation is 'pajonal' (communities of *Scirpus giganteus*), along with some exotic species and, in smaller proportion, native willows (*Salix humboldtiana*) and ceibos (*Erythrina crista-galli*), as well as some endemic plant species.

Aquatic Habitats

From a hydrographical standpoint, there are six distinct areas:

- **The zone of Chaco-Formosa marshes and sloughs:** with a surface area of approx 70,000 km^2, it extends within the following limits: to the N, Pilcomayo river; to the W, a line running from Fortín Leyes (Formosa province) through Villa Ángela (Chaco Province) up to the political borderline between the provinces of Chaco and Santa Fe; to the E, Paraná and Paraguay rivers; to the S, Tapenagá river. This area possesses an hydrological system formed by two autochthonous rivers which run in N-S direction, and also receives waters from two allochthonous courses, Pilcomayo and Bermejo rivers, which arise in Andean regions.
- **The area of marshlands and sloughs in Santa Fe province:** situated north of the lower course of Carcarañá river basin, it includes the so-called "Submeridional Lowlands" ("Bajos Submeridionales"). Its limits are: to the N, Tapenagá river (border line between the provinces of Chaco and Santa Fe); to the W, a line following the political border between Santa Fe province and the provinces of Santiago del Estero and Córdoba, and to the S, the prolongation of this same line separating this area from Carcarañá river basin. The Salado del Norte river forms an independent basin, which enters this region from Santiago del Estero. Surface area approx. 170,000 km^2.
- **Alluvial valley of Middle and Lower Paraná river course:** begining near the confluence of Paraná and Paraguay rivers, this valley lies on the right-hand margin in the Middle Paraná course, and on the left-hand margin in the Lower Paraná course. It reaches the beginning of the Paraná delta, with which it intertwines in an elongated complex formation. The fundamental feature of the flood plains is precisely the periodical flood cycle, caused by the yearly swellings of the river, so that the changes in the physical and chemical features of the environment produce a characteristic response in the biotic communities.
- **Iberá system and Corrientes ríver:** the Iberá system crosses diagonally the province of Corrientes, and it has a surface area of 12,000 km^2. It is a vast plain with very slight south-oriented slope, and its shallow basin is fed primarily by rainfall. The system drains into Paraná river through Corrientes river. It comprises a complex association of lentic and lotic environments which become intertwined in vast areas of interface. There are lagoons that communicate with each other and with the sloughs and marshlands through well-defined and active canals and finally conform a diffuse system that drains into Corrientes or Corriente river. The latter is the final collector for Iberá system; it runs in a general NE-SW direction and flows into the Middle Paraná course. Although this river is the only watercourse that drains the Iberá system, the location of Miriñay river, whose headwaters are in the immediate vicinity of Iberá, suggests the existence of some connection in past times.
- **Paraná Delta:** it forms a markedly elongated area with an extension of approx. 320 km, reaching to the beginning of the Río de la Plata with a width of little more than 60 km and representing a total surface area of approx. 14,000 km^2. It extends approximately from Villa Constitución (Santa Fe province), at the origin of Paraná Pavón river– although some authors place its northern limit in the town of Diamante (Entre Ríos province), in an area called 'Delta Viejo' (Old Delta) (Vega, 1995) – up to the place where Paraná Guazú flows into Río de la Plata. The Paraná river contributes the sediments which form the homonymous interior delta. Several rivers and canals separate a multitude of elongated islands and natural levees ("albardones"), formed by the silts deposited by the swelling waters, along with tree trunks, branches and water hyacinths that also contribute to the formation of the islands. Each of the islands is, according to Difrieri (1958), a basin full of mud where rushes (*Scirpus californicus*) ditch reeds (*Phragmites australis*), andf 'achiras' (*Canna* sp.) thrive. Vast associations of reed mace (*Zizaniopsis bonariensis*) and 'pajonales' (*Scirpus giganteus*) extend along the coasts and compact masses of rushes take root

in the shallow depths.. In general terms, the low easily-flooded areas occupy 80 % of the surface area, whereas the natural levees ('albardones') or non-flooded areas take up 20 %. The delta holds a vast network of artificial canals that facilitate the drainage and navigation in the more populated area of the system.

- **Río de la Plata:** this river is actually the estuary of rivers Paraná and Uruguay and it extends over an area of nearly 30,000 km^2. It runs from Paraná delta and the mouth of Uruguay river, reaching the ocean in a 250 km-wide front after a 300-km course. The Río de la Plata hydrographic system comprises all the tributaries of Paraná and Uruguay rivers, the main stems of these rivers, the Río de la Plata itself and some smaller streams that flow directly into Río de la Plata on both margins. Although the influence of marine waters reaches the vicinity of La Plata city (62º36'S, 62º12'W), the effect of oceanic tides is felt as far into the river as the north of Buenos Aires province, on the coasts of Paraná river, and north of Entre Ríos city, on the coasts of Uruguay river. The course of Río de la Plata can be divided in three zones: internal, intermediate and external. The internal zone is the area of the river headwaters, where the subfluvial delta is located; the oceanic influence is reflected basically in the tides that affect the whole river; the organisms living in this sector are typical freshwater forms. The intermediate zone stretches from an imaginary line extending between the cities of La Plata (Argentina) and Colonia (Uruguay), to another line uniting Punta Brava (Uruguay) and Punta Piedras (Argentina); here the sea influence is noticeable; there are some marine fish species which enter the brackish low salinity waters; on both river margins there are low floodable coasts occupied by crab colonies ('cangrejales') (species of genera *Uca*, *Chasmagnathus* and *Cyrtograpsus*). The external zone comprises the area of the river habitually demarcated by an imaginary line uniting Punta Brava and Punta Piedras and, in the outer limit, Punta del Este (Uruguay) and Punta Rasa, Cabo San Antonio (Argentina); this is the estuarial sector, with brackish waters where the greatest changes in salinity are recorded.

Biodiversity

Lower Paraguay river: 60 species (13.6%).

Middle and Lower Paraná river: 188 species (42.9 %).

Marshes of Santa Fe province: 90 species (20.4 %).

Marshes of Chaco and Formosa: 87 species (19.7 %).

Paraná river Delta: 164 species (37.2 %).

Río de la Plata and tributary watercourses: 152 species (34.7 %).

Occurring families: Table 2.

This is the area of greatest ichthyofaunistic diversity in Argentina, where most of the families belonging to the dominant groups (Ostariophysans), as well as lungfishes (Lepidosirenidae) and groups of marine origin (Clupeidae and Engraulidae, Atherinopsidae, Belonidae, Sciaenidae, Achiridae and Potamotrygoninae) occur. Within this assemblage different ecological, morphological and ethological adaptive features may be observed, and there are some remarkable migratory species (e.g. the 'sábalo', *Prochilodus lineatus*, the 'dorado', *Salminus maxillosus*, and the 'surubí', *Pseudoplatystoma* spp.). The first of these is iliophagous and is one of the most important species in the bioeconomy of the system, comprising more than 50 % of its total biomass; it is the typical forage fish for large ichthyophagous species. There are also fish species that inhabit the marshes, sloughs, ox-bow lakes, rivulets, meander plains, etc.

There are endemic species such as *Ixinandria steinbachi*, *Hypostomus laplatae*, *Rhamdella jenynsi*, *Parapterodoras paranensis*, *Hyphessobrycon igneus*, *Hyphessobrycon wajat*, *Phallotorynus victoriae* and *Megalebias elongatus* (the latter is an endemism shared with **Salado-Vallimanca ecoregion**) (Table 6).

In this area the latitudinal pauperization of the Paranoplatensean fauna becomes apparent; but, on the other side, there are a number of occasional marine species (Table 7) in the outer margins of Río de la Plata estuary, among which are members of families Ariidae, Mugilidae and Engraulidae that perform regular migrations, as well as some species that approach the coast to spawn (e.g. *Pogonias chromis*, *Mugil* sp.).

Within Iberá system, the greatest concentration of species occurs in the areas of greatest development of submersed plants.

The fish families present in the areas of Paraná Delta and Río de la Plata are very similar, with some differences at species level (Table 2).

Ichthyofaunistic remarks

Some of the emblematic species or Argentina, such as dorado (*Salminus maxillosus*) and surubí (large cat-fishes) (*Pseudoplatystoma* spp.) may be found within this assemblage, as well as a great number of 'ornamental fishes' and 'miniature fishes'. This region is also inhabited by some of the largest members of the freshwater ichthyofauna, such as manguruyú (*Paulicea luetkeni*).

Bonetto *et al.* (1989) state that the icthyofauna of Iberá system is in some ways similar to the fauna from Riachuelo river (Corrientes), and that within this assemblage two major groups of fishes may be recognized: north of Iberá lagoon there is a Northern sector with an essentially sedentary fish fauna, while the Southern sector is distinguished by the occurrence of Paranensean species that reach Iberá system through Corrientes river; these two groups are not clearly differentiated. One of the most remarkable shared features of these systems is the great abundance of piranha (*Pygocentrus nattereri* and *Serrasalmus spilopleura*).

Vulnerable species: numerous ornamental species belonging to different families, such as *Gymnocorymbus ternetzi*, some species of *Corydoras*, *Hyphessobrycon* and *Lepidosiren paradoxa* (only small juvenile specimens of the latter species are commercialized), species commercialized as live bait (Gymnotiformes, Characiformes and Synbranchiformes), annual fishes (family Rivulidae), vulnerable because of their particular breeding requirements and also because they often inhabit man-made wetlands, "miniature fish", mostly Trichomycteridae, which are poorly known forms, less than 20 mm long. In addition to these, the sea catfish (*Netuma barbus*) that performs anadromous migrations.

Biological Value

One of the remarkable features of the ecoregion is the riparian rainforest that grows along the hydrological system, with decreasing species richness in north-south or downstream direction.

The area of the alluvial valley of Middle Paraná river has special features, being a trophic and breeding area for various migratory species.

According to Bonetto and Hurtado (1998), the fishes that traverse the deltaic area do so only sporadically. On the other hand, important concentrations of silverside ('pejerrey') (*Odontesthes bonariensis*) congregate in lotic areas of the lower delta and migrate early in the year (autumn-winter) up the Lower and Middle course of Paraná river, where they are presumed to spawn in brackish waters connected to the Middle Paraná course. The Delta is also the southernmost refuge for the Marshes Deer (*Blastoceros dichotomus*) and the river otter (*Lontra longicaudis*).

From hydrological, physical and biological standpoints, the estuary of Río de la Plata is a complex system, where singular biological and migratory phenomena occur. In Samborombón bay (Buenos Aires province) two reproductive strategies have evolved among fish species: the "estuarial spawning" species use this environment as spawning area (e.g. *Brevoortia aurea, Odontesthes argentinensis, Odontesthes incisa*), while the "estuary-dependant" species spawn in high salinity waters (e.g. *Mugil liza*, *Pogonias*

chromis, *Micropogonias furnieri*, and some Pleuronectifrmes) (Lasta, 1995).

According to Bertonatti and Corcuera (2000), within this ecoregion there are "areas of outstanding diversity" representative of different biomes: Chaco Húmedo, Espinal, Pastizal Pampeano and Delta e Islas del Paraná.

Impacts/Threats

Similarly to the first ecoregion, this area faces threats such as alteration of water courses, dams and hydraulic works, habitat fragmentation, poaching, inadequate management and destruction of vegetation of the basin, resource overexploitation, advance of agropecuary activities, unregulated tourism/recreation, fluvial transportation, as well as the existence of urbane concentrations, with the accompanying industrial and portuary activity, and presence of nuclear and hydraulic centrals. An additional element is the presence of exotic species such as *Cyprinus carpio, Acipenser* cf. *baeri* and *Hypophthalmichthys molitrix*.

The areas of Delta and Río de la Plata suffer the influence of the major urbane conglomerates of Argentina, such as the cities of Rosario (Santa Fe province) and Buenos Aires. One of the most affected areas is the so-called "Rosario-Magdalena Arc" which comprises part of the provinces of Santa Fe and Buenos Aires. In certain areas (e.g. Río de la Plata) pollution has led to the disappearance or marked reduction of valuable species, such as dorado (*Salminus maxillosus*), pirapitá (*Brycon orbignyanus*), surubi (*Pseudoplatystoma* spp.) and pacú (*Piaractus mesopotamicus*).

Another noteworthy aspect is the transferral of waters from the impoundment at Yacyretá into Iberá system, with the consequent flooding of fields and wood patches due to the rise of the aquifer level (Blanco & Parera, 2001).

National Protected Areas

Río Pilcomayo National Park (Formosa).
Chaco National Park (Chaco).
Mburucuyá National Park (Corrientes).
Pre-Delta National Park (Entre Ríos).
Otamendi Strict Natural Reservation (Buenos Aires).
Colonia Benítez Strict Natural Reservation (Chaco).

Ramsar sites:

Río Pilcomayo National Park (Formosa)
Jaaukanigas river.
Iberá marshes and lagoons

Correspondence

Wetlands: Región 1, Región 2 and Región 3 (Cuenca I) .

Ecoregions: Chaco Húmedo, Esteros del Iberá, Campos y malezales, Delta e Islas del Paraná, Espinal (part) and Pampa (part).

Zoogeography: Subtropical Domain (part of Chacoan and Mesopotamic Districts) and part of Pampasic Domain.

Rationale

The elements that validate the proposed ecoregion are the following:

- the endemic species mentioned above.
- Rivers Paraguay and Paraná, which function as the way of entrance for tropical and subtropical aquatic fauna. In addition to fishes, zooplanctonic elements such as some species of rotifers (José de Paggi, 1990) and malacostracan crustaceans (Morrone & Lopretto, 1994) may be mentioned.
- the setting established by the alluvial plains of Middle Paraná and Delta, conforming

a series of biotopes that foster high degrees of biodiversity and support and shelter certain developmental stages of fish populations (e.g. trophic and reproductive migrations of *Prochilodus lineatus* (Bonetto & Castello, 1986; Sverlij *et al.*, 1993; Sivansander *et al.* 2001)).

- The estuary of Río de la Plata acting as a site where complex physical and biological phenomena occur, and as entrance for certain elements of marine origin.
- The entire ecoregion is highly dynamic and is influenced primarily by the hydrological changes occurring in the upper portion of the main watercourses and by the influence of the maritime front on the Río de la Plata estuary. In addition, the anthropogenic influence which has promoted, among other consequences, the geographical retraction of certain species within Río de la Plata, such as *Brycon orbignyanus* and *Ageneiosus valenciennesi*, and the entrance, by way of the same watercourse, of exotic species such as the Asian bivalves *Corbicula fluminea* and *Limnoperma fortunei* (Ituarte, 1981; Darrigran & Pastorino, 1985); the latter has reached Yacyretá impoundment in Alto Paraná course.

Relevant Bibliography

Risso & Morra (1964); Ringuelet (1967); Miquelarena *et al.* (1980); Cousseau (1985); Boschi (1988); Bucher *et al.* (1993); Baldo *et al.* (1993/94); Almirón *et al.* (1992); Menni *et al.* (1992); Quintana *et al.* (1992); Vega (1995); Liotta *et al.* (1995/96); Neiff (1996); Zalazar (1996); A.A., AGOSBA, ILPLA, SHN (1997); del Barco (1997); Azpelicueta (1998); Bonetto & Hurtado (1998); Braga (1998); Mercado *et al.* (1998); Nion (1998); Wells & Daborn (1998); Almirón & Casciotta (1999); Liotta (1999); Almirón *et al.* (1992, 2000); Colombo *et al.* (2000); Chediak (2000); Remes Lenicov & Colautti (2000); Schnack *et al.* (2000); López *et al.* (1996); Baigún & Oldani (2001).

3) LOWER URUGUAY RIVER ECOREGION

Limits

To the N, with the **Misioneran ecoregion**, to the S and W with the **Subtropical Potamic Axis ecoregion** by means of the watershed between Paraná and Uruguay rivers, including all the latter's tributaries in Argentina and, tentatively, the area of Uruguay river tributaries in Brazil and Uruguay.

Description

This ecoregion includes the areas drained by Uruguay river in Argentinian territory, except for the portion belonging to the **Misioneran ecoregion**. This basin occupies part of the provinces of Corrientes and Entre Ríos. The river arises in Brazilian territory and after a course of 2,200 km it joins Paraná river to form Río de la Plata. The basin presents a variety of geomorphological features, including numerous valleys and an extremely branched ("braided") fluvial system formed by short steep-sloped watercourses, and a series of waterfalls and whitewaters in the main stem, including the waterfall situated near Salto city (Uruguay Republic) where Salto Grande dam has been built. Downstream from these formations, the river narrows, forming islands and sandbanks; just before its mouth, a numerous canals establish communication between Uruguay and Paraná rivers. This sector receives strong influences from Río de la Plata river.

Surface area: approximately 60,230 km^2.

Terrestrial habitats

The northern portion of this ecoregion has basaltic influences from the Brazilian Planalto or Central Plateau, while the southern areas feature sedimentary plains. The plant communities comprise vast grasslands with high diversity of grasses such as 'flechilla' (*Stipa neesiana*), 'espartillo amargo' (*Elionurus muticus*), 'paja colorada' (*Paspalum quadrifarium*) and, in some areas, some hard-woodlands formed by ñandubay (*Prosopis nandubay*), algarrobo (*Prosopis* sp.), molle (*Schinus molle*) and yatay palm

trees (*Butia yatay*).

Aquatic habitats

In the northern portion of the ecoregion there are lowlands crossed by short rivers, while the sedimentary plains in the southern area features slow-drainage watercourses with poorly-defined river beds, as well as slough formations draining into Miriñay and Aguapey rivers, or directly into Uruguay river.

Biodiversity

Uruguay river: 133 species (30.2%)

Occurring families: Table 2

This ecoregion has high ichthyofaunistic affinities with Paraná river (Sverlij *et al.*, 1998), albeit with less fish species (30.2%) and absence of certain families such as Lepidosirenidae, Gasteropelecidae, Hypopomidae and Belonidae (Table 2). The only recorded endemism is *Loricariichthys edentatus*.

Ichthyofaunistic remarks

The fish assemblage present in this area has suffered the impact of Salto Grande impoundment. There have been detectable changes in the fish communities related to the environmental modifications brought about by the building of the dam. Among these, some remarkable phenomena have been: an increase in the abundance of planktophagous species characteristic of free-flowing waters (e.g. *Parapimelodus valenciennis* and *Lycengraulis simulator*), while some sedentary species such as *Hoplias malabaricus* have undergone marked regression; differential incidence on migratory species, since the populations of some species (e.g. *Prochilodus lineatus* and *Salminus maxillosus)* have shown some recovery after initial decrease, but others (e.g. *Pseudoplatystoma* or *Sorubim lima*) still show declining tendencies. Some species, such as *Piaractus mesopotamicus* and *Brycon orbignyanus,* have not been captured since the closing of the dam; in this case, these frugivorous species have suffered the consequences of the deforestation of the river margins.

In the lower sector of Uruguay river, the significant biomass of the populations of *P.lineatus*, exploited for industrial uses (elaboration of flour and oils) as well as for direct consumption, supports important commercial fisheries.

Vulnerable species: species used as live bait (*Synbranchus marmoratus* and species of *Cheirodon* and *Astyanax*), ornamental species such as the Rivulidae (aquarism) mentioned above (for **Potamic Subtropical Axis ecoregion**).

Biological Value

This ecoregion includes areas of outstanding biodiversity and protected areas representative of the Pampas grasslands ('Pastizal Pampeano'). Presence of endangered species of mammals such as the marshes deer (*Blastoceros dichotomus*).

Impacts/Threats

Advance of agropecuary activities, modification of watercourses (hydraulic works, impoundments), habitat fragmentation, inadequate management, destruction of the vegetation of the basin, mining activities, presence of urban conglomerates, unregulated tourism/recreational activities, poaching, overexploitation of resources. Presence of exotic species: *Acipenser* cf. *baeri*, *Cyprinus carpio* and the Asian bivalve *Corbicula flaminea* which has become an important element in trophic webs.

National Protected Areas

El Palmar National Park (Entre Ríos province)

Ramsar Sites

None.

Correspondence

Wetlands: Region 1.

Ecoregions: Campos y Malezales, Espinal, and Pampa.

Zoogeography: Subtropical Domain**,** Pampean Province.

Rationale:

The elements that validate the proposed ecoregion are the following:

- The physical and hydrologic characteristics of Uruguay river, which support a Paranoplatensean ichthyofauna that is apparently less diverse than the one in Paraná river.
- The river functions as a way of entrance for tropical-subtropical aquatic fauna, such as malacostracan crustaceans (Morrone & Lopretto, 1994).
- The river, whose upper course is winding and irregular, becomes a more typical plain river approximately from the level of Santo Tomé town. Its main stem becomes wider (1,200 m at Paso de los Libres, Corrientes province) and its elevation decreases, providing a favorable habitat for the development of important populations of 'sábalo' (*Prochilodus lineatus*). The river also supports populations of other migratory species.

Relevant Bibliography

Di Persia & Neiff (1986); Spinetti *et al.* (1992); Bonetto (1994); Espinach Ros & Ríos Parodi (1997); Sverlij *et al.* (1998); Chediak (2000); Reis & Pereira (2000); Oldani *et al.* (2001).

4) EASTERN PARANOPLATENSEAN ECOREGION

Limits

To the N, this ecoregion abuts with Paraguay and Bolivia; we have tentatively included neighboring areas drained by Paraguay river system in the ecoregion. To the W with **Western Paranoplatensean** and **Central Endorrheic ecoregions.** To the S, with the northern portion of **Western Paranoplatensean ecoregion** and **Salado-Vallimanca ecoregion**, approximately following the watershed for Salado river in Buenos Aires province; to the E, with **Subtropical Potamic Axis ecoregion**.

Description

Situated approximately between 61ºW and 65º W, an area comprising the upper (for Argentina) courses of allochthonous rivers such as Pilcomayo and Bermejo, and other watercourses such as Salado del Norte or Juramento, San Francisco and part of Grande de Jujuy rivers.

Surface area: approximately 417.200 km^2.

Main basins: part of the middle course of Pilcomayo river, Bermejo river (except for its lower course), and the above mentioned watercourses.

Terrestrial Habitats

This ecoregion combines elements of 'yungas' – the cloud forest irregularly distributed in the provinces of Salta, Jujuy, Tucumán and Catamarca – with vast plains, with slight eastward slope, occupied by sedimentary deposits of the large Chacoan-Pampean tectonic hollow.

The vegetation, according to the different zones, includes trees such as white 'tipa' (*Tipuana tipu*), 'timbó' (*Enterolobium contortisiliquum*), 'lapacho rosado' (*Tabebuia avellanedae*), 'nogal' (*Juglans australis*), xerophilous woods with 'espinillos' (*Acacia caven*), 'horco-quebracho' (*Schinopsis haenkeana*), savannahs and grasslands.

Aquatic Habitats

The ecoregion includes the major part of the course of Pilcomayo river in Argentina, Bermejo river, San Francisco, Salado del Norte or Juramento river, and in its southern portion rivers Tercero, Cuarto and Carcarañá. Except for Pilcomayo river, which merges with Paraguay river, the resto of these watercourses flow into Paraná river along different parts of it. Additionally, there are diverse wetlands arising from the hydrologic complexity of the area.

Biodiversity

Pasaje - Juramento – Salado system: 42 species (9,85%).

Tercero - Cuarto – Carcarañá system: 37 species (8,4 %).

Itiyuro or Caraparí river: 2 species (0,5 %).

Pilcomayo river: 75 species (17,0 %)

Bermejo river: 116 species (26,3 %)

Occurring families: Table 2.

Although the number of species in this ecoregion is important, it's lower than the values for **Subtropical Potamic Axis ecoregion**.

There are three endemisms which also occur in **Central Endorrheic ecoregion**: *Hypostomus cordovae, Loricaria tucumanensis* and *Trichomycterus tenuis*; and two exclusive species: *Rhamdella aymarae* and *Jenynsia maculata*.

Ichthyofaunistic remarks

Within the province of Formosa there is a reduction in species richness in E-W direction (79 species vs. 41, with 31 shared species). Some families are absent: Gymnotidae, Hemiodidae, Crenuchidae, Trichomycteridae, Lebiasinidae and Aspredinidae (Menni *et al.*, 1992). Two of the factors that contribute to this reduction are the already discussed E-W impoverishment and the decrease of aquatic vegetation, correlated to the arid conditions in the area, which reduces the availability of niches for certain species.

The endorrheic Itiyuro river basin, located in Salta province (22° 07'S, 63° 11'W), 500 m above sea level, has only two species recorded; one of them the endemic *Rhamdella aymarae* (Miquelarena & Menni, 1999).

In the province of Jujuy there is a thermal water course inhabited by a singular species assemblage with ethological particularities. This group is formed by 16 species occurring in a high temperature-high salinity habitat, of which 19 are Characiformes, 4 are Siluriformes and 2 are Perciformes (Menni *et al.*, 1998).

Vulnerable species: *Loricaria tucumanensis* and some species of Cyprinodontiformes, as well as the species which are subject to the hydrologic variability of aquatic habitats in this area.

Biological value

It's part of an ample semi-arid plain that occupies over 1,200,000 km^2 in South America and 800,000 km^2 in Argentina (the rest being distributed in Bolivia and Paraguay). The vegetation is dominated by subtropical thorny woods and semi-arid and humid savannahs, with significant species richness especially in the southern sector. Despite the aridity of some habitats, there are numerous wetlands of diverse origins, with a variety of physical and biological features. Some areas shelter diverse and abundant avian populations, providing breeding areas (for resident species) as well as wintering areas (for Patagonian and Pampean species).

Impacts/Threats

Alteration of water courses, dams and hydraulic centrals, habitat fragmentation, poaching, resource overexploitation, inadequate management and destruction of vegetation of the basin, unregulated tourism/recreation, as well as the existence of urbane concentrations, industrial activities, mining and oil extraction activities. Presence of exotic species such as *Cyprinus carpio, Oncorhynchus mykiss*, and *Gambusia affinis*.

National Protected Areas

Baritú National Park (Salta province)
Calilegua National Park (Jujuy province)
El Rey National Park (Salta province)
Los Cardones National Park (Salta province)
Formosa National Park (Formosa province)
Copo National Park (Santiago del Estero province)

Ramsar sites

None

Correspondences

Wetlands: Region 2

Ecoregions: Chaco Seco, Selva de las Yungas, Espinal and Pampa

Zoogeography: Subtropical Domain, Pampasic Domain, Andean Domain, Central or Subandean Domain.

Rationale:

The elements that validate the proposed ecoregion are the following:

- The heterogeneous aquatic habitats that support diverse ichthyofaunistic associations.
- Absence of certain families, such as Clupeidae, Pristigasteridae, Engraulidae, Belonidae, Sciaenidae, which are present in **Subtropical Potamic Axis ecoregion**.
- Decrease in species number when compared to **Subtropical Potamic Axis ecoregion**, directly correlated with the smaller surface area occupied by basins in this ecoregion.
- Presence of thermal watercourses with species adapted to high temperature and salinity conditions.

Relevant Bibliography

Casciotta *et al.* (1989); Menni *et al.* (1992); Haro & Bistoni (1996); Bucher & Chani (1998); Haro *et al.* (1998); Menni *et al.* (1998).

5) CENTRAL ENDORRHEIC ECOREGION

Limits

To the N, the northern watershed of Tala river basin and San Esteban hills (Salta province).

To the E, the boundary with Pasaje-Juramento-Salado system (Salado river basin) marked by the mountain ranges of Sierras de la Candelaria and the riverbeds of Muerto, Mista and Los Gómez watercourses. See further comments in the description of the basin.

To the W, a series of sierras (Carahuasi, Aconquija, de la Carreta, Humaya, Las Higueritas and del Potrerillo), the hills that mark the Huacra or San Francisco river basin

towards Catamarca province and the dry bed of this stream, and the valley enclosed between Sierras Grandes and Comechingones in the west, and Ancasti sierras in the east.

To the S, an imaginary line following the boundaries of Segundo river basin (about 31° 50'S) and extends from Cerro Negro (Comechingones sierras system) through the towns of Monte Ralo, Oncativo and Devoto, reaching Mar Chiquita lagoon.

Description

This ecoregion comprises almost all of the territory of Tucumán province, the western and southern sectors of Santiago del Estero province and the northwest of Córdoba province. The landscape is subject to rapid transformation due to erosive and sedimentary processes, accelerated mainly by the poor management of soils and vegetated areas. The area undergoes significant periodic floods that affect vast areas. Another frequent phenomenon is the transferral of waters from Dulce river to Salado del Norte river, when the river flows over the drainage divide. There are numerous small and middle sized endorrheic water courses that become salt pans ('salinas') during the dry season.

Surface area: about 149,800 km^2.

Main basins: Salí-Dulce river system (Salí river changes its name to Dulce after Río Hondo impoundment), Mar Chiquita ('Ansenuza Sea') basin with rivers Primero and Segundo, and various rivers and lesser streams situated in the northwestern region of Córdoba province.

The main dams are El Cadillal (Tucumán province) on the Salí river course, and Río Hondo, situated in the provinces of Tucumán and Santiago del Estero, between 27º 27' S and 27º 39' S, and 64º 52' W and 65º 05' W.

Terrestrial Habitats

The dominating plant communities are the xerophyle woods, included in the Chaco Seco biome. There are also abundant Sierran woods, savannahs and grasslands. In the higher flat areas communities such as xerophyle 'quebracho' woods (species of *Aspidosperma* and *Schinopsis*), thorny shrubs, etc. In some of the lower areas, where the salinity conditions and the restricted drainage affect the floristic assemblage, communities of 'algarrobo' (*Prosopis* spp.) and 'chañar' (*Geoffroea decorticans*) occur, and halophyte plants grow in the areas of salt plains. There are alternating forest and grassland formations, the latter associated with filled-in riverbeds. In the sierras portion of Chaco, palm-tree associations including 'carandilla' (*Trithrinax campestris*) also occur.

There are fragmentary patches of 'Yungas' (cloud forest) formations in Tucumán province, generally associated with the subandean sierras.

Aquatic Habitats

- **Salí-Dulce river**: its active basin is situated in the provinces of Tucumán, Salta and Catamarca. Most of its main tributaries descend from the Aconquija and Calchaquí sierras formations. Salí river is formed in the junction of Tala and Candelaria rivers (each with several tributaries). When the river exits Río Hondo impoundment it receives the name of Dulce river and flows over flatlands, receiving almost no tributaries and flowing finally into Mar Chiquita lagoon. The basin presents considerable altitudinal variation, ranging from 270 m above sea level at Río Hondo impoundment to 70 m above sea level at Mar Chiquita lagoon.
- **Primero (Suquía) river**: it's surrounded by areas of considerable urban concentrations. Its upper course receives two main tributaries: Cosquín river with its own tributaries (San Francisco river and various creeks and rivulets) and San Roque river with tributaries Chorrillos river, San Antonio creek, etc.; the latter flows into the artificial lake in San Roque dam.

- **Segundo (Xanaes) river**: the basin boundary extends from Pampa de Achala, through the towns of Alta Gracia, Río Segundo and Cañada de Machado to Mar Chiquita lagoon; to the S, an imaginary line from Cerro Negro (Comechingones hills system) through Monte Ralo, Oncativo, Devoto, to Mar Chiquita lagoon. Hydrographically the basin has three areas:

  a) Zone of sierras, on the N, S and W zones of the basin, with a surface area of approximately 2,000 km^2, including the two main feeding water courses, rivers De los Molinos(with its tributaries San Pedro river and various creeks, that contribute their waters to the impoundment in Los Molinos dam) and Anizacate (with its tributaries de la Suela and San José rivers).

  b) Zone of plains, from the headwaters of Segundo river itself to Villa del Rosario (Córdoba province), surface area about 4,000 km^2.

  c) Zone of marshes: marshes formed by the main stem and also by other brooks and creeks that run parallel to Segundo river, with a surface area of 6,700 km^2.

- **Mar Chiquita "Laguna" (lake) (Sea of Ansenuza):** situated in the low saline grounds in the NE of Córdoba province, between 26°-32° S and 62°-66°W, along with the saline Los Porongos lagoons. Mar Chiquita has a surface area that fluctuates between 2,000 y 6,000 km², being 140 km long and 100 km wide. It's one of the world's largest saline lakes; it's far from populated areas. Its main features are its shallow depths and brackish waters, with salinity values ranging from 40 to 250 g/l, according to the water level in the lagoon. This water body is particularly subject to flood-drought cycles produced by summer rains that fall upstream in the basin. A conspicuous rise in the water level of this lagoon started in 1970 and continues to this day; simultaneously, the waters contributed by the tributary streams have determined a marked decrease in the saline concentration that has fostered the advance of the silverside *Odontesthes bonariensis,* introduced in the area.

- **Rivers of the NW of Córdoba province**: this basin comprises the rivers, creeks and rivulets that descend from the western slopes of the Córdoba sierras. To the N, its limit is a line extending from El Tuscal (Salinas Grandes), through La Esperanza to San Francisco de Chañar; to the W, a line that borders Salinas Grandes, El Tuscal, San José, San Antonio, Serrezuela and the southernmost tip of the salt flats to the south, through Pinas, Los Cerrillos, to Piedra Blanca creek (in the San Luis-Córdoba border); to the S, through Piedra Blanca creek to the heights of Comechingones sierras; to the E, from San Francisco del Chañar passing through various hills to La Cumbre, then from Sierra Chica to Sierra Grande, Pampa de San Luis and Pampa de Achala to Piedra Blanca creek.

  This basin comprises two sectors:

  a) **Salinas Grandes slope,** including the rivers of the northern area (western slope) that flow toward the Salinas Grandes salt plains. Most of these water courses are only connected to the salt plains during the rainy season; the rest of the year, their courses fade into marshes or are absorbed by sand expanses ('arenales'). Cruz del Eje river, with its tributaries Pintos, Avalos and de la Candelaria rivers, is one of the main water courses, with a basin surface area of approximately 1,700 km^2. Other important rivers are Pichanas, de Soto, Los Sauces and Guasapampa.

  b) **Western sector**: the water courses descend from the western slope of the central mountain range. The only important river is San Pedro or de los Sauces, formed by the intersection of Mina Clavero and Panaholma rivers. Other water courses are Chancarí river and various creeks.

Biodiversity

Salí-Dulce river: 64 species (14.5 %).

Primero river: 21 species (4.8 %).

Segundo river: 20 species (4.5 %).

NW Córdoba water courses: 11 species (2.5 %).

Occurring families: Table 2.

There are endemic species in Primero and Segundo basins (e.g. *Bryconamericus eigenmanni* and *Astyanax cordovae*) as well as some species of Loricariidae and Trichomycteridae that are unique to Argentina (e.g. *Hypostomus cordovae* and *Trichomycterus tenuis*). Another endemic species is *Loricaria tucumanensis* (an endemism also present in some areas of Jujuy province included in **Eatern Paranoplatensean ecoregion**) (Menni *et al*., 1998). *Trichomycterus alterus* and *Jenynsia pygogramma* are endemic species shared with **Subandean-Cuyan** and **Western Paranoplatensean ecoregions**. (Table 6).

Ichthyofaunistic remarks

The pauperization of the paranoplatensean ichthyofauna is evinced in the main hydrogegraphical axis of the ecoregion, the Salí-Dulce river (Table 4). Throughout this basin some orders, such as Myliobatiformes, Clupeiformes, Lepidosireniformes, Beloniformes and Pleuronectiformes, are absent (Table 2); the absence of Trichomycteridae in Dulce river is a particular feature.

Vulnerable species: *Trichomycterus corduvensis* (Miatello, 1994), *Loricaria tucumanensis* (Vides-Almonacid *et al.*, 1998).

Biological value

The system includes some 'areas of outstanding diversity' of Chaco Seco and Chaco Serrano (Bertonatti & Corcuera, 2000).

The sector of Pampa de Achala (Córdoba province) has a significant number of endemisms; e.g. Achala toads (*Bufo achalensis* and *Pleurodema kriegii*), Achala 'escuercito' toad (*Odontophynus achalensis*), and the Achala green lizard (*Pristidactylus achalensis*), as well as endemic subspecies of birds and mammals, and one endemic invertebrate (the scorpion *Urophonius achalensis*).

Impacts/Threats

Urban concentrations; hydraulic works; agropecuary activities; mining activities; various industries. Introduced fish species: *Cyprinus carpio*, *Gambusia affinis*, *Oncorhynchus mykiss*, *Carassius auratus.*

National Protected Areas

Campo de los Alisos National Park (Tucumán).

Quebrada del Condorito National Park (Córdoba).

Ramsar Sites

None.

Correspondence

Wetlands: Region 2.

Ecoregions: Chaco Seco, Espinal.

Zoogeography: Subtropical Domain (Chacoan District) and Pampasic Domain.

Rationale

The elements that validate the proposed ecoregion are the following:

- An important reduction in the number of species relative to those that occur in **Subtropical Potamic Axis ecoregion**, that is correlated with the already discussed

general pauperization in east-west direction (Table 4). This is evinced here by the absence of some orders and families (Table 2) that may have inhabited the area in former times, as demonstrated by fossil records of Cynodontidae and Scienidae from Middle Miocene in Salta province (Cione & Casciotta, 1995).

- The presence of endemic species in Salí, Primero and Segundo river basins.
- The NW region of Córdoba province might represent an ecotonal area between the Paranoplatensean and Subandean-Cuyan provinces (Menni *et al.*, 1984).

Relevant Bibliography

Bonetto *et al.* (1976); Casciotta *et al.* (1989); Miquelarena *et al.* (1990); Buti & Miquelarena (1995); López *et al.* (1996); Miquelarena & Aquino (1995); Haro & Bistoni (1996); Reati *et al.* (1997); Bucher & Chani (1998); Cabido (1998); Fernández (1998); Buti & Cancino (1999); Miquelarena & Aquino (1999); Anónimo (2000); Kutel & Bistoni (2000).

6) WESTERN PARANOPLATENSEAN ECOREGION

Limits

This ecoregion includes two sectors.

Septentrional Sector: The limits for the Northern sector are: to the N, the political border in Salta province, from 22º 08' S. To the W, the mountain range of the Andes from 22º08'S and 68º36'W; although we have extended tentatively these limits to include some neighboring basins in Bolivia. To the E, from 65º11'W the area is bound by Pilcomayo river basin (included) and part of Bermejo river basin, the watershed separating Pasaje-Juramento-Salado basin (which is included in the **Eastern Paranoplatensean ecoregion**) and **Central Endorrheic ecoregion** (see description for Salí-Dulce basin). To the S, the limits between Abaucán river basin (included in the ecoregion) and Vinchina or Bermejo basin (this river is a tributary of Desaguadero river and is included in the **Subandean-Cuyan ecoregion**); this division between the watersheds coincides in the western portion with the political Catamarca-La Rioja border, and partially with the heights of Famatina orographic system. This limit continues in the Paiman sierra that separates the Blanco and Achavil river basins, to the E by watercourses such as Anguil river and other tributaries of Los Sauces river (that descend from Velazco hills), and then turns south including the marshes where Salado river disappears (Desagües del Salado). These marshlands are situated south of Ambato hill, in La Rioja province (approximately at 66º30'W).

Meridional Sector: to the N the limit is over the 32ºS parallel between 64º50'W and 66º55'W. To the W, the 66º55' meridian between 32º and 33º40' S, and south of approximately 33º30' this limit reaches the 64ºW meridian to include Quinto river basin in San Luis and Córdoba provinces. To the S, following the watershed of Quinto river, as a diagonal line extending from approximately 34º S and 66º30'W to 34º30'S and 63º40'W. To the E, the meridional sector abuts with **Eastern Paranoplatensean** and **Salado del Sur-Vallimanca ecoregions**.

Description

The ecoregion encompasses varied landscapes: a prolongation of the Bolivian Altiplano, with mountain ranges including several volcanoes; an arid region with varied geological, geomorphological and altimetric features associated with the cordilleran system and the subandean hills; and also a sector with dense forest cover. Heights vary between 400 and 4,500 m.; there are valleys, elongated in north-south direction, ample slopes, and little-sloped plains derived from intermountain valleys.

Surface area: approximately 248,760 km^2.

Main basins: rivers Quinto, Conlara, Chorrillos; the rivers descending from the western and northern slopes of San Luis sierras: rivers Nogolí, Amieva, San Francisco, San

Martín, Cautana, etc.; the lagoons in southern San Luis province.

In addition to the mentioned watercourses, there are streams with headwaters located in the mountains of Andean and Subandean orographic systems.

Terrestrial Habitats

Different plant associations according to the altitudinal gradient: shrubby steppe, open woods with low trees such as 'queñoa' (*Polylepis tomentella*), and shrubs as 'jarillas' (*Larrea* sp.), 'retamo' (*Bulnesia retama*), 'pichana' (*Psila spartioides*), tall cactuses or 'cardones' (*Trichocereus* sp.), halophytic communities (rushes), other trees such as 'algarrobos' (*Prosopis* sp.), and cloud forest species such as white 'tipa' (*Tipuana tipu*) and laurel (*Phoebe* sp.).

Aquatic Habitats

This ecoregion features diverse high-elevation wetlands (saltpans and lagoons), temporary endorrheic or poorly drained basins, and some permanent watercourses associated with the gradual thawing of mountain snow.

The Meridional sector includes all the endorrheic watercourses that flow down from the San Luis hill system and the western slopes of Comechingones sierras, in San Luis province, as web as tose from the eastern slope of Alto Pencoso hills.

Quinto river basin, with a surface area of approximately 1,800 km^2, is the main watercouse in San Luis province. Some of its tributaries are Grande and De la Cañada Honda rivers; further on downstream it receives Saladillo stream, whose main contribution is subterranean. Quinto river disappears forming the sloughs called 'Bañados de La Amarga', situated in southern Córdoba province.

This ecoregion also includes the 'Salinas del Bebedero' saltpans, which used to be connected with Desaguadero river basin (Central Endorrheic ecorregion), and an area in southern Córdoba province which undergoes sporadic floods due to the swelling of Quinto river, although these phenomena are at present attenuated by La Florida dam built in Quinto river.

Biodiversity

Tributaries to Pipanaco saltflats: : 11 species (2,5 %).

Del Valle and Dorado rivers: 3 species (0,7 %).

Abaucán, Colorado or Salado river: 3 species (0,7 %).

Del Valle (other) river and watercourses from eastern slope of Ambato hills (Catamarca province): 3 species (0,7 %).

Rivers and streams of the Puna region: 1 specie (0,2 %).

Quinto river: 5 species (1,1 %)

Chorrillos river: 2 species (0,5 %)

Occurring families: Table 2.

The endemic species are *Rineloricaria catamarcensis, Trichomycterus catamarcensis* and *T. ramosus*; other endemic species, *T. roigi, T. alterus* and *Jenynsia pygogramma* also occur in **Central Endorrheic** and **Subandean-Cuyan ecoregions** (Table 6).

Ichthyofaunistic remarks

The occurrence of fish species is associated with the altitudinal range of this ecoregion; there are endemisms, largely among the Trichomycteridae.

This ecoregion comprises two sectors which form an ichthyofaunistic unit, although they are apart from a geographical point of view. Their similitudes include families in common, such as Trichomycteridae, Characidae y Pimelodidae; and similar biomes.

Biological value

This ecoregion comprises 'areas of outstanding biodiversity' of diverse biomes: 'Yungas', 'Monte', 'Puna', 'Prepuna' and 'Andes Áridos'.

Impacts/Threats

Mining and agropecuary activities; hydraulic works, construction and laying of gas ducts.

National Protected Areas

Laguna de los Pozuelos Natural Monument (Jujuy province)

Ramsar Sites

Laguna de los Pozuelos Natural Monument (Jujuy province)

Vilama lagoons (Jujuy)

Correspondence

Wetlands: Regions 6 and 2 (in part)

Ecoregions: Altos Andes, Puna, Monte de Sierras y Bolsones, Selva de las Yungas.

Zoogeography: Subtropical Domain, Andean Domain, Central or Subandean Domain.

Rationale

The elements that validate the proposed ecoregion are the following:

- This area marks the western distributional limit of Paranoplatensean ichthyofauna, with species of Characidae and Loricariidae.
- Occurrence of endemic species of Trichomycteridae and Anablepidae, also shared with **Subandean-Cuyan** and **Central Endorrheic**.
- Presence of endemic species of Trichomycteridae associated with altitudinal variations.

Relevant Bibliography

Boulenger (1902);Marini *et al.* (1933); Arratia & Menu Marque (1984); Bucher & Chani (1998); Sarmiento *et al.* (1998); Fernández (2000); Fernández & Vari (2000).

7) SALADO DEL SUR-VALLIMANCA ECOREGION

Limits

To the SE the ecoregion reaches Samborombón bay (coastal Buenos Aires); to the NE it borders the **Subtropical Potamic Axis ecoregion**; to the NW, it abuts on the **Eastern Paranoplatensean Ecoregion**; to the W, on La Pampa province (no-records area) excepting a narrow eastern area included within this ecoregion); to the SE, on the **Bonaerensean Atlantic Drainage ecoregion**.

Description

This ecoregion is situated in the sector of flat 'pampas' (plains), and comprises a wide central area in Buenos Aires province, from Samborombón bay in the E to La Pampa province in the west, including numerous and varied aquatic environments. The lagoons have two types of cross-sectional profile: some of them, with more regular borders and generally smaller and less stable, have *pfanne*- or plate-shaped beds; other lagoons, which are larger and more stable, generally with more irregular borders and also interconnected (chained lagoon system or "encadenadas"), have more of a tub- or barrel-shaped cross-sectional profile. The NW arid area is the most arid part of the ecoregions; the hydrographic network has no drainage and undergoes alternating wet and dry periods

determined mainly by the precipitation/evaporation ratios. The lotic habitats are flatlands streams, which are generally temporary, and man-made drainage canals.

Surface area: about 179,000 km^2.

Main basins: two large rivers, Samborombón and Salado del Sur, with their tributaries. Other water courses are Vallimanca stream and the endorrheic basins situated in the NW and SW of the ecoregion.

Terrestrial Habitats

This ecoregion features horizontal or slightly ondulated plains, with some low hills (up to 1,200 m) emerging as islands in the flat landscape. The dominant plant community is the graminaceous steppe or pseudosteppe, and there are also prairies, psammophyte and halophyte steppes (with species such as *Salicornia ambigua* and *Chenopodium macrospermum*), riparian forests and diverse types of hydrophytes (e.g. rushes: *Schoenoplectus californicus* and *S. americanus*). This landscape has undergone important modifications due to the influence of human activities, especially the advance of the agropecuary activities.

Aquatic Habitats

- **Salado del Sur river**: this river is the southernmost tributary of Río de la Plata; it runs over plains and its bottom is flat and covered by siltation processes. The river forms several marginal lagoons and develops numerous winding meanders along an ample and almost flat valley. Its basin is Y-shaped, with two main branches; one of them arises in a series of lagoons situated in the SE of Santa Fe province; the other, in Departamento de Saladillo (Buenos Aires province). The river is about 690 km long and it flows finally into the sea at Samborombón bay. In addition to its surface tributaries, it also receives water from underground sources.
- **Samborombón river**: this is also a flatlands stream, with low margins and a shallow valley; it runs for some 150 km and reaches Samborombón bay, where it flows into the Atlantic Ocean.
- **Vallimanca creek**: the main tributary of the Salado del Sur river. Its headwaters are in the southern part of Partido de Bolívar (Buenos Aires province), it runs following the boundary of the basin and finally flows into Salado del Sur river through a man-made canal (Canal 16).
- **Lentic habitats**: within the valley of Salado river there are 339 lagoons of variable salinity, of which 125 are temporary. The Encadenadas (chained lagoons) of Chascomús have been fairly researched; this lacustrine system comprises, among others, the 'lagunas' (permanent ponds) Vitel (13 km^2), Chascomús (30 km^2), Adela or Manantiales (21 km^2), del Burro (11 km^2), Tablillas (17 km^2), Chis Chis (15 km^2) and Las Barrancas (9 km^2), all of them interconnected via short water courses and flowing finally into Salado river by way of the last mentioned lagoon. They are part of the Northern and Marginal Group of Frenguelli (1956).

  In the SW sector there are 61 lagoons (37 of them temporary), and the main ones form the Encadenadas del Oeste system (Alsina, Cochicó, del Monte, del Venado and Epecuén), with a surface area of nearly 580 km^2. One of their main features is the marked salinization gradient that increases westwards (López *et al.*, in press). These lagoons are part of the Diagonal Group of Frenguelli (1956).

Biodiversity

Salado del Sur river: 43 species (9.8 %).

NW Pampean basins: 3 species (0.7%)

SW Pampean basins: 17 species (3,9 %)

Occurring families: Table 2.

There is one exclusive endemic species, *Austrolebias nonoiuliensis*, and another endemic species, *Megalebias elongatus*, which also occurs within the **Subtropical Potamic axis ecoregion** (Table 6).

One of Argentina's emblematic species, the silverside ('pejerrey') *Odontesthes bonariensis*, exhibits high productivity within the Salado basin.

In the NW sector of the ecoregion, occurrences of fishes are almost non-existent, with the exceptions of the records for *Odontesthes bonariensis*, *Cyprinus carpio* and *Rhamdia quelen* in El Hinojo lagoon (López *et al.*, 1991) and *Jenynsia* sp. (D. Colautti, pers. comm.).

Ichthyofaunistic remarks

The Salado river basin marks the southern limit for the distributional range of most of the paranoplatensean species. We may add to the reasons commented by other authors (Ringuelet, 1975; Menni & Gómez, 1995; Gómez, 1996) the characteristics of the Río de la Plata estuarial ecosystem, especially at its external zone, where the waters are brackish and the salinity is variable (Boschi, 1988).

The decrease in species richness becomes apparent in general NE-SW direction. The effect of the barriers, mainly ecological in nature, is indicated in the absence of at least three orders and eleven families which are frequent in the Río de la Plata basin (Table 2). Within the occurring species, Characiforms are dominant over Siluriforms by 38 % (López *et al.,* 2001).

The presence of one of the emblematic species of Argentina, the "pejerrey" (freshwater silverside), that has been the object of much research and diverse literature (Ringuelet, 1943; López *et al.*, 1991; Grosman, 1995, 2001) is worthy of mentioning.

The species of the genera *Austrolebias* and *Megalebias* represent a group with remarkable reproductive features, adapted to temporary water bodies that become dry and dissapear in summer.

The mullet (*Mugil liza*), whose biology in this area is poorly known, is the only amphibiotic species (Table 7).

A significant phenomenon is directly related to the swellings of the main rivers that form the Río de la Plata system, especially Paraná river. These events produce an expanded flow of fresh water into Samborombón bay, and allow the entrance to Salado river of some species that are frequently mentioned as occasional for the basin. Among these we may mention *Brevoortia pectinata, Prochilodus lineatus, Acestrorhynchus pantaneiro, Salminus maxillosus, Hyphessobrycon meridionalis, Pygocentrus nattereri, Serrasalmus spilopleura, Callichthys callichthys, Trachelyopterus striatulus, Ageneiosus valenciennesi, Luciopimelodus pati, Pimelodus maculatus* and *Gymnotus carapo.*

Vulnerable species: those species used as bait (genera *Cheirodon* and *Astyanax* and the swamp eel, *Synbranchus marmoratus*), and those considered ornamental (aquarism) such as the species of Rivulidae already mentioned in the discussion of the **Subtropical Potamic Axis ecoregion**.

Biological value

A reduced and fragmented population of Pampa's deer (*Ozotoceros bezoarticus*) inhabits the area of 'cangrejales' (crab colonies) in Samborombón bay (Merino, 1994).

Salado river acts as a "temporary corridor" for the ichthyofauna, many species occurring occasionally within the watercourse.

The Salado basin and the system of chained lagoons of Chascomús are considered as "area of outstanding biodiversity", as well as the Samborombón bay area.

The crab colonies in Samborombón bay, the Encadenadas lagoons of Chascomús and the Salado del Sur are considered as unique environments by Canevari *et al.* (1998).

Impacts/Threats

Agropecuary expansion, watercourse alteration, habitat fragmentation, inadequate management, overexploitation of resources and unregulated tourism/recreational activities.

Desertification phenomena are occurring in the northeastern portion of the Salado basin.

The only exotic species that has become acclimated in the Salado basin is the common carp, *Cyprinus carpio*. As in other areas of Argentina, this species has been particularly successful in Buenos Aires province and it's estimated to occur in over 90 % of the freshwater environments of the province (López *et al.*, 1996). Along with the silverside, this species forms the largest ichthyic biomass for this basin and, although there has been an increase in knowledge of its ecology (Colautti, 1997), the effect of this species on ecological systems is still being discussed (Grosman, 1995). Apart from this, the species *Oncorhynchus mykiss* has been introduced in some hilly areas, with variable success (Table 3).

National Protected Areas

None.

Ramsar Sites

Samborombón bay.

Correspondence

Wetlands: Region 3, excepting part of Basin I and Basin IV.

Ecoregions: Pampa.

Zoogeography: Pampasic Domain.

Rationale

The elements that validate the proposed ecoregion are the following:

- It is the southern distributional limit for most of the paranoplatensean species, and many orders and families of common occurrence in the **Subtropical Potamic Axis ecoregion** are absent here (Table 2).
- The singular arrangement of the hydrographical system, consisting of one plains river that from its origin is associated with diverse lacustrine systems, achieving a particular dynamic flow that is unique in Argentina.
- Another particular feature of the Salado del Sur river is its function as "temporary corridor" for certain fish species at times of occurrence of global hydrological events such as the extensive floods in the **Subtropical Potamic Axis ecoregion**. These conditions produce changes in physical and chemical factors in the area that could explain the occurrence of some of the so-called "occasional" species.
- The presence of the endemisms *Austrolebias nonoiuliensis* and *Megalebias elongatus* (the latter, as we have mentioned, also occurs in the **Subtropical Potamic Axis ecoregion**.

Relevant Bibliography

Toresani *et al.*, (1994); Iriart (1997); Gómez & Toresani (1998); López *et al.* (1991, 1993, 2001); Van Eerden & Iedema (1994); Miquelarena & López (1995).

8) BONAERENSEAN ATLANTIC DRAINAGE ECOREGION

Limits

To the N, this ecoregion abuts mostly on Salado del Sur-Vallimanca ecoregion (Salado river basin), following an imaginary line passing south of Canal 2 (which flows into Samborombón Bay), including all watercourses south of it. To the NW, by the watershed formed by the Balcarce and Tandil hills, from the Atlantic coast and reaching Tandil city. To the E, the basin is closed by the sand dunes which lie along the Atlantic coast, behind the beaches. To the W, the limit is an imaginary line in southwestern Buenos Aires province, including Sauce Chico river basin and Chasicó lagoon and all its tributary watercourses. To the SW, the no-records area separates this area from **Patagonian ecoregion**.

Description

This is a region where plains are the prevailing landscape, and two hilly formations stand out: septentrionlly Sierras de Tandil, and meridionally Sierra de la Ventana. The Tandil hills have metamorphic and sedimentary rocks, it's approximately 300 km long, 50 km wide and has an average height of 450 m. Sierra de la Ventana is an outcrop of Paleozoic sedimentary rocks, with an average height of 700 m (its maximum height is 1,239 m). Another outstanding feature is the area where Chasicó lagoon is situated, which is several meters under sea level.

Surface area: approximately 67,880 km^2.

Main basins: this area has scarce hydrographically significant features; there are no major watercourses. Some of the rivers are Quequén Grande, Quequén Salado and Sauce Grande.

Terrestrial Habitats

These are similar to the ones in **Salado del Sur-Vallimanca ecoregion**; among the grasslands, the sand dunes represent true "islands" with scarce vegetation including the characteristic 'Pampa's grass' (*Cortaderia selloana*), and inhabited by typical flora and fauna.

The 'talares' (associations of 'tala' *Celtis tala* and other species of bushes and low trees) are the only autochthonous arboreal formations in the 'pampas', a landscape that has undergone significant changes due to anthropogenic activities.

The coasts of Mar Chiquita coastal lagoon are occupied by salt marshes with clayish soils, inhabited by dense crab colonies and other invertebrate fauna.

Aquatic Habitats

This ecoregion includes all watercourses descending from the western slope of Tandilia and Ventania systems, e.g. rivers such as Sauce Grande, Chelforó, Napaleofú, Quequén Grande, Claromecó, and Napostá Grande. Some of the rivers flow directly into the sea coast, while others reach the ocean indirectly through other streams or man-made canals, and yet others disappear in sloughs or lagoons, the development of which is fostered by the presence of the coastal sand dunes.

An outstanding feature is Salada Grande lacunar complex, with a surface area of 1,350 km^2.

Mar Chiquita coastal lagoon has a surface area of some 5,000 has and its maximum depth ranges between 4.9 m and 1.8 m (in low periods). It's separated from the ocean by the surrounding sand dunes and connected to it by a narrow mouth. The oceanic influence on the coastal lagoon is variable and depends on several factors. This waterbody receives also waters from various streams (such as Las Gallinas, Grande, Vivoratá, and Dulce streams). The landscape is markedly dynamic, due to accretion and erosion proceses, and changes in the shape of the marine coasts of the area and the

mouth of the lagoon are relatively swift.

In a more southerly location, in Monte Hermoso city, Sauce Grande lagoon has a surface area of 2,290 ha.

There is one artificial lentic body in the ecoregion: Paso de las Piedras dam, built on Sauce Grande river. The impoundment has a surface area of 3,300 ha and an average depth of 10 m.

Biodiversity

Pampean basins of Atlantic drainage: 26 species (5,9 %).

Occurring families: Table 2.

There are no endemic species.

Ichthyofaunistic remarks

There are 26 species in this area (5.9%) (Table 1). This assemblage comprises widely distributed Brasilic species such as *Cheirodon interruptus, Astyanax eigenmanniorum, Bryconamericus iheringi, Hyphessobrycon anisitsi, Oligosarcus jenynsii* (Characiformes*); Rhamdia quelen, Corydoras paleatus* (Siluriformes); "*Cichlasoma*" *facetum* (Perciformes) and *Synbranchus marmoratus* (Synbranchiformes); as well as families with marine and euryhaline representatives (e.g. Clupeidae, Mugilidae and Atherinopsidae) (Table 7). The presence of the alter is related to breeding activities in the area.

Vulnerable Species: none.

Biological Value

The wetlands in this area give shelter to populations of diverse species and function as concentration sites for migratory shorebirds. The crab colonies might be considered of international significance according to Ramsar criteria.

Mar Chiquita coastal lagoon is an estuarial environment with high biological richness and diversity, considered as a wildlife shelter of regional importance.

The marine coastal area is inhabited by important populations of anchovy (*Engraulis anchoita*) and Plata river dolphin (*Pontoporia blainvillei*).

It's included in the areas of outstanding biodiversity of the Pampean Region.

Impacts/Threats

Agriculture, agropecuary expansion, alteration of watercourses, urban expansion, habitat fragmentation, inadequate management, resource overexploitation, unregulated tourism/recreational activities, energy generation, portuary activity.

The only exotic species recorded in this ecoregion is the black bass, *Huro salmoides*, which was introduced in Laguna de Los Padres lagoon approximately 40 years ago. There are no current records of its presence there.

National Protected Areas

None.

Ramsar sites

None.

Correspondence

Wetlands: Region 3, in part (basins IV and VI).

Ecoregions: Pampa.

Zoogeography: Pampasic Domain.

Rationale

The elements that validate the proposed ecoregion are the following:

- Absence of endemisms.
- Presence of euryhaline families, due to the combination of the significant marine coast with the lentic and lotic environments which are associated with it.
- The existence of Mar Chiquita coastal lagoon, a sheltering and breeding area for diverse species.
- The southern distributional limit of species considered 'indicators of ichthyological regions', belonging to Characiformes, Siluriformes, Perciformes and Synbranchiformes, is found within this ecoregion.

Relevant Bibliography

Dangavs, N. V. (1988); Padín *et al.* (1991); Gómez & Toresani (1998); Casciotta *et al.* (1999); Cousseau *et al.* (2001); Iribarne (2001).

9) SUBANDEAN-CUYAN ECOREGION

Limits

To the N, the borders of **Western Paranoplatensean ecoregion** following diverse watersheds (see description of that ecoregion). To the S, with the NW sector of **Patagonian ecoregion**. To the W, the watershed formed by the Andes mountain range. To the E, with the SW sector of **Central Endorrheic ecoregion**, with part of San Luis province, included in the meridional sector of **Western Paranoplatensean ecoregion**, and with the no-records area.

Description

This ecoregion comprises all of the province San Juan, most of the provinces of La Rioja and Mendoza, the NW of La Pampa and two narrow elongated areas in the western and northern peripheral areas of San Luis.

López (2001) states that Mazza (1961) in his hydrological classification included this ecoregion between the areas of **Interior Rivers without oceanic drainage** and **Atlantic drainage rivers**. Bonnetto (1994) situates this area within his Region III, that he designated as **Atlantic drainage rivers of Patagonic-Chilean Subregion**. Marzo and Arias (1975) included this fluvial system within **Rivers of the Andean hydrographical system**, situated in the so-called 'Arid diagonal' in South America. This group of rivers have been called indistinctly Andean or 'Desaguadero' system; its main tributaries are rivers Jáchal, San Juan, Mendoza, Tunuyán, Diamante and Atuel. The collector river for these streams flows through an area of dry courses, sloughs and lagoons, and finally into the upper course of Colorado river.

There is also the lacustrine complex of Guanacache lagoons, situated in the border between the provinces of San Juan, Mendoza and San Luis.

The saline Llancanello lagoon (650 km^2) lies south of the city of San Rafael (Mendoza); it receives waters from Mendoza river, Mocho and Chacay creeks and also significant contributions from phreatic waters (Iglesias & Pérez, 1998).

Surface area: 365,000 km^2.

Terrestrial habitats

Following a W-E direction, this ecoregion features the Cordilleran mountain area with the highest mountains of the American Continent, such as Mt. Aconcagua with 6,959 m (Mendoza province) and Mt. Mercedario with 6,770 m (San Juan province); eastwards, the Precordillera (Subandean ranges), and in the east, arid plains, sometimes called 'travesías', with some isolated hills that belong to the Pampean orographic system. The

plant communities that grow in this area are poorer than in the so-called 'Monte de Sierras y Bolsones' biome; these two are considered as the most xerophytic of Argentinian biomes.

In the provinces of La Rioja and San Juan, the valleys that lie between the mountains originate plains with little slope (depressions) where some basins with poor or non-existent drainage (known as 'bolsones') develop. In these areas the dominant plants are species of *Larrea*, along with 'retamo' (*Bulnesia retama)*, 'pichana'(*Cassia aphylla)*, 'brea' (*Cercidium praecox*), and others that conform the typical 'jarillal' (Creosote bush) community (Monte de Sierras y Bolsones).

The Chaco Seco (see description of terrestrial habitats in **Central Endorrheic ecoregion** is also represented in the eastern sector of La Rioja province.

Aquatic habitats

The Desaguadero river basin that crosses the ecoregion arises in the border between the provinces of Catamarca and La Rioja, at about 6,000 m above sea level, and it covers 30 % of La Rioja, 90 % of San Juan, 50 % of Mendoza, the western border of San Luis and part of La Pampa. Several dams have been built along the course of this system. There are also some small streams, often temporary (e.g. the Bermejo or Vinchina river in La Rioja).

Some of the fluvial systems have undergone artificial interconnecting of their courses for better exploitation of their flow, e.g. the canals that connect the middle courses of Mendoza and Diamante rivers to Tunuyán and Atuel rivers respectively.

Mendoza and San Juan rivers feed the Guanacache lacustrine system, which has a length of about 200 km and a surface area of some 5,800 km^2. This system was once an important center for fishery activities (Larrain, 1906, **In**: Villanueva & Roig, 1995; Bucher & Chani, 1998). Throughout the years it suffered diverse anthropogenic impacts and the effects of climatic cycles, which altered the water levels; the system was receding until 1998, but at present it has entered a recovery stage.

Llancanelo lagoon, situated to the southwest of Mendoza province, occupies an ecotonal area between the biogeographical provinces of Monte, Andean and Patagonic, receiving faunistic and floristic elements of pampean, Andean and subandean origin (Iglesias & Pérez *op.cit.*)

Biodiversity

Mendoza river: 9 species (2.0 %).

Main collector for Desaguadero system: 8 species (1.8 %).

Tunuyán river: 6 species (1.4 %).

San Juan river: 3 species (0.7 %).

Tributaries of Chilecito valley (La Rioja province): 2 species (0.5 %).

Jáchal river: 2 species (0.5 %).

Diamante river: 1 species (0.2 %).

Atuel river: 2 species (0.5 %).

Bermejo de La Rioja river (La Rioja province): 1 species (0.2 %).

Tributaries to Llancanelo lagoon: 4 species (0.9 %).

Occurring families: Table 2.

The distinctive ichthyofaunistic elements are families Diplomystidae and Percichthyidae, which are endemic for the Neotropica and reach their southernmost distributional range within this ecoregion. Among the Ostariophysi, there are representatives of orders Characiformes, with genera *Astyanax* and *Cheirodon*; and Siluriformes, with the endemic species *Diplomystes cuyanus*, *Trichomycterus alterus, T. heterodontum, T. riojanum* and *Silvinichthys mendozensis* (Tables 2 and 6). In addition,

there are species of orders Atheriniformes, Cyprinodontiformes (*Jenynsia pygogramma*), Synbranchiformes, Perciformes and exotic Salmoniformes. To sum up, the **Subandean-Cuyan ecoregion** has presently 20 recorded species distributed among eight families, four of them exotic (Tables 2 and 3).

Ichthyofaunistic remarks

The presence of a species of order Synbranchiformes in the central-southern areas of San Juan province (Murúa & Acosta, 1995) supports the pressumption that *Synbranchus marmoratus* might inhabit the area of Guanacache lagoons (Mac Donagh, 1950; Rusconi, 1961, **In:** Villanueva & Roig, 1995) and in Meré lagoon (coast of Araujo, in Lavalle, Mendoza province) (H. Sosa, pers. comm.). The record in San Juan (31°37'S, 68° 30'W) is the westernmost reference for this species, which constitutes yet another Paranensean element in the Subandean-Cuyan Ichthyogeographic Province. The system of Guanacache lagoons, according to the zoogeographical outline for Mendoza province (Roig & Contreras, 1975), are part or the so-called "Fauna of aquatic and halophyle environment". The presence of *S. marmoratus* within these brackish habitats suggests that the species may have currently unidentified special ecophysiological traits (see Cione & Barla, 1997). In addition to the exotic species that have been introduced and are discussed below, the 'Bonaerensean Silverside' (*Odontesthes bonariensis*) has been transplanted into this ecoregion.

Vulnerable species: the intense exploitation of the watercourses for different purposes, such as irrigation, dams, etc., represents a threat for the entire aquatic life in the area, which is occupied by the Diplomystidae and Percichthyidae, endemic Neotropical families forming a group with particular ecological adaptations. With respect to the diplomystid catfishes, their biology and ecology are poorly known, as most of the research about the group has been focused on phylogenetic issues (Arratia, 1987, 1992). Arratia *et al.* (1983) state that the distribution of family Percichthyidae is not clear due to the management implemented by governmental organizations, and add that 'Ultimately, the limit of the natural distribution of *Percichthys* in Argentina extends more towards the south than it does in Chile'.

Biological value

It comprises some of the "areas of outstanding biodiversity" of Monte biome.

Llancanelo lagoon possesses very diverse and numerous avifauna (Sosa, 1995; Martínez *et al.*, 1997). It is also a nesting area for its most representative species, the common flamingo (*Phoenicopterus chilensis*). The rodent *Tympanoctomys barrerae*, found in this area, inhabits halophyle areas and is endemic to Mendoza province.

The Guanacache lacunar system is situated in an ecotonal area between the Chacoan region and the desertic areas that occupy the west of Argentina.

Impacts/Threats

Advance of agropecuary activities; alteration of watercourses (hydraulic works, dams such as El Nihuil and Valle Grande); habitat fragmentation; inadequate management and destruction of the vegetation of the basin; unregulated tourism/recreation; urban conglomerates; resource overexploitation; oil extraction, mining and industrial activities; poaching; consumptive water extraction (e.g. from Malargüe river, that feeds Llancanelo lagoon).

In addition, the presence of exotic species such as *Cyprinus carpio*, *Ctenopharyngodon idella*, *Carassius auratus* and *Oncorhynchus mykiss* (Table 3).

National Protected Areas

San Guillermo National Park (San Juan province).
Western sector of Sierra de las Quijadas National Park (San Luis).
Talampaya National Park (La Rioja).
El Leoncito Strict Natural Reservation (San Juan).

Ramsar Sites

Llancanelo lagoon (Mendoza).
Guanacache lagoons (San Luis, San Juan and Mendoza).

Correspondence

Wetlands: Regions 2 and 4.
Ecoregions: Altos Andes, Monte de Sierras y Bolsones, Monte de Llanuras y Mesetas.
Zoogeography: Central or Subandean Domain, Patagonic Domain.

Rationale

The elements that validate the proposed ecoregion are the following:

- Presence of endemic families such as Diplomystidae and Percichthyidae, which occur exclusively in South America and reach their southern distributional limit within this ecoregion (San Juan province) at about 31° S.
- The basal phylogenetic position of the Diplomystidae that supports the high-priority conservation interest (Stiassny & Pinna, 1994).
- Presence of one endemic genus and species of Trichomycteridae, *Silvinichthys mendozensis*.
- The ecotonal character of the eastern and southeastern portions of this ecoregion, in the areas occupied by Guanacache and El Rosario lagoons, and Llancanelo lagoon, respectively.
- Presence of *Odontesthes hatcheri*, an endemic Atherinopsidae that also occurs in Chile.

Relevant Bibliography

Wernicke (1932); Peñafort (1981);Villanueva *et al.* (1992); Arratia (1998).

10) PATAGONIAN ECOREGION

Limits

To the N it's bound by the **Subandean-Cuyan ecoregion** and an imaginary line that runs in west-east direction from the northern limit of the Colorado river basin, bordering the "no-records" hiatus situated in the north-center portion of the province of La Pampa and continuing eastwards until reaching the Atlantic coast at Verde peninsula (approximately 39°30'S, 62° 10'W). To the E, the ecoregion is limited by the Atlantic ocean. To the W, the Andean heights establish the watershed separating the Pacific drainage watercourses (not included).

Description

The Argentinian Patagonia is situated south of Colorado river, bound to the west by the Andes mountain range and to the east by the Atlantic Ocean. Patagonian relief is not even; the moderately high mountain range that extends in N-S direction is the most conspicuous geomorphologic feature. In their middle section and eastwards, the mountains lose height and give way to hilly elevations, and finally blend with the Patagonides orographic system. Nevertheless, the major morphological unit corresponds to the plateau. This doesn't have a regular surface but has many different aspects: the extensive plains that receive the name of pampas (e.g. Pampa del Castillo, Chubut province, at 1,000 m above sea level); the sierras, with heights ranging from 1,000 to 1,800 m.; the river valleys (called 'cañadones" when they are dry) that cross the plateau in W-E direction; and the lowlands known as 'bajos' (the great lowland in Valdés Peninsula, situated 45 m under sea level).

The geomorphology of the area is the result of a complex geological history, due to the Pleistocene glaciations that affected severely the middle latitudes in South America. By

the end of that geological period, the climatic warming fostered the formation of many lakes along the Andes mountain range. These lakes, that can have tectonic, periglacial, volcanic, eolic or karstic origins (Markgraf, 1988) range from shallow to deep, and from intermittent to permanent. Those of periglacial and volcanic origin are situated close to the Andes, while those of eolic erosion origin are found in extra-Andean Patagonia. Aluminé lake (Neuquén province) is the first in the series of cordilleran lakes, among which we may mention lakes Nahuel Huapi, Buenos Aires and Fagnano, the latter shared with Chile.

In the mountain area of Santa Cruz province there are immense glaciers such as Perito Moreno, with a front area 5 km wide and 60 m high.

The eastern part of Grande de Tierra del Fuego island is occupied by the Argentinian province of Tierra del Fuego, bordered by the Argentinian Sea (Atlantic Ocean) and separated by Beagle channel from several Chilean island situated southwards. This province has moderately high plateaus in the north and center of the territory, and the south part is occupied by an extension of the arid Andes creating a mountainous relief.

Surface area: 756,400 km^2.

Terrestrial Habitats

The dominant plant communities are shrubby steppes, while the more humid regions are occupied by cushion plants and grassy steppes. In the valleys where the small streams form bogs, dense graminaceous and cyperaceous prairies called 'vegas' grow along with other herbaceous plants. In the areas of low saline soils the plants are halophyte and generally have succulent leaves.

The subpatagonian (also called subantarctic or Andean-patagonian) forests develop in a narrow area along the mountain slope from the northern regions of Neuquén province extendind to Tierra del Fuego and Estados island. The dominant plant formation is a semideciduous temperate-humid forest. To the north this assemblage is replaced by the Chilean Valdivian Forest with several characteristic tree species such as *Araucaria araucana* and *Nothofagus* species.

Aquatic Habitats

This ichthyogeographic province is included in the categories **Ríos interiores sin derrame al mar** and **Ríos de vertiente atlántica** (Mazza, 1961) and **Región III – Ríos de vertiente atlántica de la Subregión Patagónica Chilena** (Bonetto, 1998). Some of the lotic water courses arise in complex headwaters situated in the Andean macizo and then become connected with lesser water courses and, in some cases, with oligotrophic lakes. These courses pass onto the Patagonic plateau, where they don't receive any tributaries, and finally flow into the Atlantic ocean (e.g. Negro river). There are also endorrheic basins, wide oligotrophic lakes (such as Nahuel Huapi, Fontana, Fagnano, etc.) and impoundments such as Alicurá, Florentino Ameghino, etc. (see Calcagno *et al.*, 1995). In addition, the **Vertiente Pacífica** (Mazza, 1961) or **Pendiente del Océano Pacífico** (Daus, 1975) comprises a fluvio-lacustrine system arising on the eastern slope within Argentinian territory and draining into the Pacific ocean in Chile (e.g. lakes Lácar, San Martín and Fagnano).

According to Baigún (2001) there are three groups of lakes:

1) Oligotrophic Andean lakes, which are stratified and have low conductivity (including the large very deep lakes), and shallow lakes, which are never stratified, have higher conductivity and low transparency.
2) Ecotonal lakes, situated in Andean and Subandean spurs; these are very deep, never stratified, meso- to eutrophic and have moderate to high levels of nutrients and conductivity.
3) Plateau lakes and impoundments, with two types: a) deep, oligotrophic and with summer stratification; b) large lakes and impoundments with moderate depth,

generally non-stratifying, with high levels of nutrients and conductivity and low transparency.

Biodiversity

Colorado river: 13 species (2.9 %).

Negro river: 12 species (2.7 %).

Chubut-Senguerr- Chico rivers: 9 species (2.0 %).

Chico-Santa Cruz rivers: 5 species (1.1 %).

Deseado river: 4 species (0.9 %).

Tierra del Fuego streams: 5 species (1.1 %).

Malvinas Islands: 3 species (0.7 %).

De los Estados Island: 1 species (0.2 %).

Occurring families: Table 2.

The ichthyofauna is characterized by the presence of Diplomystidae and Percichthyidae (which also occur in **Subandean-Cuyan ecoregion**) with endemic species such as *Diplomystes viedmensis, D. mesembrinus, Percichthys colhuapiensis, P. vinciguerrai* and *P. altispinnis* (Table 6)*;* there is also one species of Atherinopsidae (also occurring in Chile) *Odontesthes hatcheri*, in addition to the notogeic representatives of orders Osmeriformes (family Galaxiidae), Siluriformes, Cyprinodontiformes and Perciformes.

In addition the exotic species discussed below, the Bonaerensean silverside ('pejerrey') *Odontesthes bonariensis* and *Jenynsia multidentata* have been transplanted into this ecoregion.

Ichthyofaunistic remarks

With respect to the overlapping of brasilic and austral ichthyofauna that has been recorded between the Colorado and Negro rivers (Almirón *et al.*, 1997), we believe that this area has been subject to deep anthropogenic modifications (such as irrigation systems and transplantation of native species). This situation demonstrates the eurytopic condition of certain species that spread following man-made canals. Given all this, we don't consider it advisable to draw zoogeographical conclusions over highly modified environments.

Vulnerable species: Chébez (1994) includes *Aplochiton taeniatus* and *A. zebra* within the "Vulnerable" category. By means of a methodological analysis, Bello and Úbeda (1998) conclude that *Diplomystes mesembrinus* is the species that should have the maximum conservation priority among the 15 threatened fish species. These authors indicated that 60 % of the species deserve special consideration, among them, *D. mesembrinus, D. viedmensis, Trichomycterus areolatus, Percichthys altispinnis, P. vinciguerrai, P. colhuapiensis, Aplochiton zebra* and *A. taeniatus*. According to Grigera (1999), the latter's populations have decreased as a consequence of the introduced salmonid populations.

Biological Value

Patagonia comprises an assemblage of fragile and heterogeneous ecosystems.

Its wetlands harbor nesting colonies of some endemic aquatic bird species, as well as supplying shelter for other migratory aquatic birds of Holarctic origin and habitats for some charismatic species such as *Melanocorhyphus* sp. and *Rallus antarcticus*.

There are also endangered mammals such as the otter *Lontra provocax*.

Impacts/Threats

Advance of agropecuary activities, watercourse alteration (hydraulic works, impoundments), habitat fragmentation, inadequate management, destruction of the plant communities of the basin, unregulated tourism/recreational activities; urban conglomerates, resource overexploitation , portuary activities, oil extraction, mining and industrial activity, furtive fishing, consumptive extraction of water from the basin.

Exotic species: *Cyprinus carpio, Salvelinus fontinalis, Salmo salar sebago, Salmo trutta, Oncorhynchus mykiss, Oncorhynchus tshawytsha* (Table 3).

National Protected Areas

Petrified Forests National Monument (Santa Cruz province).

Lago Puelo National Park and Natural Reservation (Chubut).

Laguna Blanca National Park and Natural Reservation (Neuquén).

Lanín National Park and Natural Reservation (Neuquén).

Los Alerces National Park and Natural Reservation (Chubut).

Los Arrayanes National Park (Neuquén).

Los Glaciares National Park and Natural Reservation (Santa Cruz).

Nahuel Huapi National Park and Natural Reservation (Neuquén-Río Negro).

Perito Moreno National Park and Natural Reservation (Santa Cruz).

Tierra del Fuego National Park (Tierra del Fuego).

Ramsar sites

Laguna Blanca National Park (Neuquén).

Costa Atlántica Tierra del Fuego Reservation (Tierra del Fuego).

Correspondence

Wetlands: Regions 4 and 5.

Ecoregions: Monte de Llanuras y Mesetas, Estepa patagónica, Bosques patagónicos, Islas del Atlántico Sur.

Zoogeography: Patagonian Domain, Austral-Cordilleran Domain, part of Andean Domain.

Rationale

The elements that validate the proposed ecoregion are the following:

- As in the case of the **Subandean-Cuyan ecoregion**, the presence of the endemic families Diplomystidae and Percichthyidae, whose distributional range extends southwards to Chubut-Senguerr-Chico rivers for the former and Chico-Santa Cruz rivers for the latter.
- The basal phylogenetic position of the Diplomystidae that supports the high-priority conservation interest (Stiassny & Pinna, 1994).
- The presence of *Odontesthes hatcheri*, an endemic species of Atherinopsidae, occurring also in Chile.
- The presence of members of order Osmeriformes, a group of Notogeic origins whose geographical distribution has originated different hypotheses and considerations (Mac Dowall, 1971; Ringuelet, 1975; Cione & Barla, 2000).

Relevant Bibliography

Mariazzi *et al.* (1987); Baigún & Marinone (1995); Cifuentes *et al.* (1996); Ferriz *et al.* (1998), includes about 360 references about this ecoregion; Modenutti *et al.* (1998); Yorio (1998); Zagarese & Williamson (2001).

11) SOMUNCURÁ ECOREGION

Limits

The Somuncurá ecoregion comprises a small area situated in Río Negro province, completely surrounded by the **Patagonic ecoregion**. It's located approximately between 40° 30'S and 41° 45' S, and between 65°30'W and 68°W, on the homonymous plateau.

Description

The Somuncurá plateau has an average height of 1,300-14,00 m and it's situated about 100 km from the Atlantic coast. The structure resulted from the volcanic activity that occurred in the Mio-Pliocene, and apparently its features were not affected by glaciations or marine ingressions.

According to Menni and Gómez (1995), the plateau comprises three distinct altitudinal levels, directly associated with the morphohydrological characters: the volcanic heights, situated between 2,000-1,500 m (e.g. Mt. Corona), the level of clay-bottom lagoons (between 900 and 1,500 m), and the ravines or "filter-creeks level" (between 500 and 900 m).

Surface area: about 23,640 km^2.

Terrestrial Habitats

According to Cei (1969) this area has been erroneously included in the phytogeographical province of "Monte" (*Larrea* sp. associations). He states that over 900 m above sea level, a veritable "peninsula" of herbaceous and shrub patagonic steppes has developed in general SW-NE direction, whereas between 500 and 900 m there is an ecotonal association of patagonic and 'Monte' elements.

Aquatic Habitats

At the second altitudinal level (1,200-1,400 m) temporary lagoons with particular features develop in some circular land depressions (e.g. Raimunda, Miñuelo, and Chara lagoons). These water bodies are separated from each other by distances of 3 to 10 km; they are shallow (average depth 1.5 m) and have muddy bottoms originated from degraded clayish basalts. Their waters are rich in organic matter and suspended clay, but have very poor saline content. In spite of the lack of aquatic vegetation, plankton is abundant (several species of copepods, ostracods, cladocers, etc.).

The creeks found at the third level (500-900 m) feature very different environmental conditions. Dense associations of grasses, ferns, etc., grow along their margins. In clear waters there are colonies of *Azolla*, mosses, etc., and rich plant and animal communities develop in diverse sectors of these streams. Some of the watercourses have thermal conditions, such as Valcheta creek that will be discussed with more detail later. These streams, situated at about 600 m above sea level, arise from spring waters situated in the northern slopes of the plains, where precipitations accumulate for short periods in shallow ponds, and then percolate into underground deposits, from which water flows slowly.

The headwaters of Valcheta creek are situated at the already discussed lower level. This stream is formed by two water courses that merge after running for about 15 km over the plains. After coursing for another 75 km over the Chanquín Valley depression, the creek flows into Curicó lagoon, in the vast Valcheta Lowland ('Bajo'), situated north of the

plateau, along with other neighboring streams, such as Pajalta and Nahuel Niyeu creeks.

Biodiversity

From an ichthyofaunistic standpoint, the only recorded species is *Gymnocharacinus bergi* (0.2 %). In the lower course of Valcheta creek other Paranensean species, such as Jenynsia multidentata and Cnesterodon decemmaculatus, occur. Their presence is probably due to anthropogenic spread, as in the case of the exotic salmonids.

Ichthyofaunistic remarks

During the last 25 years *Gymnocharacinus bergi*, a species belonging to a family widely distributed in the Neotropica, has received special attention in various research works (Lüling, 1978a and b, Miquelarena & Arámburu, 1983; Wegrzyn *et al.*, 1992; Menni & Gómez, 1995; Ortubay *et al.*, 1997; Escalante & Menni, 1999; Lozada *et al.*, 2000). Menni and Gómez (1995) indicated that the thermal condition of the Valcheta creek headwaters may explain the occurrence of this species in patagonic water bodies. These authors stated that the chemical composition of the water in this creek falls within the range of the conditions found in environments frequented by characins. According to bioessays performed by Ortubay *et al.* (1997), the species is unable to spread to neighboring temperate water bodies or to sites where water temperature fluctuations are more marked because of its thermal physiology characteristics.

The reasons for the absence of *C. decemmaculatus* and *J. multidentata* from the upper course of Valcheta creek are yet unknown, although Menni and Gómez (1995) have conjectured that previous competition with *G. bergi* might be one of them.

Vulnerable species: Chébez (1994), Bello and Úbeda (1998) and Bertonatti and Corcuera (2000) place *G. bergi* within the 'Threatened species' category.

Biological value

This ecoregion is an ancient emergent area that, as we have already stated, was not affected by glaciations and other geological phenomena that left their mark upon adjacent areas. Its geological and biogeographical isolation is highlighted by the presence of several endemisms; besides the characid *Gymnocharacinus bergi*, there are anurans such as *Somuncuria somuncurensis* and *Atelognathus reverberii*, reptiles such as *Liolaemus somuncurae* and *Phymaturus somuncurensis*, and mammals such as *Lagidium viscacia somuncurensis.*

The aquatic entomofauna features a combination of Neotropical, Andean and Subantarctic lineages (Spinelli & Muzón, 2000). In addition, the presence of phlebotomid dipterans (G. Spinelli, pers. comm.) supports the hypotheses about the relictual condition of various components of the aquatic biota of the Somuncurá plateau (Ringuelet, 1961).

Bertonatti and Corcuera (2000) consider this as one of the "areas of outstanding biodiversity" for the Patagonian steppe.

Impacts/Threats

Agropecuary activities, destruction of the vegetation of the basin, inadequate management, introduction of exotic salmonids (*Oncorhynchus mykiss*) (Table 3).

Protected National Areas

None.

Ramsar Sites

None.

Correspondence

Wetlands: Region 4.

Ecoregions: Monte de llanuras y mesetas.

Zoogeography: Patagonian Domain.

Rationale

The elements that validate the proposed ecoregion are the following:

- Based on the previous comments, this region is a relictual area, widely different from its arid surroundings, being thus unique within Argentinian territory.
- In addition to *Gymnocharacinus bergi*, the plateau gives shelter to endemic species and subspecies belonging to other animal taxa.
- *Gymnocharacinus bergi* features extremely peculiar morphological characteristics. The species undergoes scale reabsorption during its ontogeny, from which it derives its common name “naked characin” ('mojarra desnuda'), and in addition it shows a marked trend towards the reduction of several osteological structures (Miquelarena & Arámburu, 1983).

Relevant Bibliography

Steindachner (1903); Pozzi (1936); Ortubay & Cussac (2000).

CONCLUSIONS

By means of the preceding anális we establish eleven ecoregions distributed within the three Ichthyogeographic Provinces proposed by Ringuelet (1975) and Arratia *et al.* (1983). These ecoregions are distributed as follows:

Paranoplatensean Province	Misioneran Ecoregion
	Subtropical Potamic Axis Ecoregion
	Lower Uruguay River Ecoregion
	Eastern Paranoplatensean Ecoregion
	Central Endorrheic Ecoregion
	Western Paranoplatensean Ecoregion
	Salado del Sur-Vallimanca Ecoregion
	Bonaerensean Atlantic Drainage Ecoregion
Subandean-Cuyan Province	Subandean-Cuyan Ecoregion
Patagonian Province	Patagonian Ecoregion
	Somuncurá Ecoregion

Various factors explain the delineation of eight ecoregions within the Paranoplatensean Ichthyogeographic Province; in the first place, the great latitudinal and longitudinal extension, together with the altitudinal range, give rise to a great variety of environments; this ecosystemic heterogeneity in turn offers a substantial multiplicity of distinct habitats; on the other hand, the dynamics of rivers Paraná, Uruguay, Paraguay and Río de la Plata, coupled

with the rivers of Andean origin such as Pilcomayo and Bermejo, promotes the presence of a diverse ichthyofauna that encompasses about 97 % of the total fish species from continental waters in Argentina and decreases in E-W and N-S directions. Certain areas have been left out of the ecoregions due to the lack of occurrence records, for instance, the tributaries to Uruguay river, Gualeguay river (Entre Ríos province), the drainage area of the upper and middle courses of rivers Pilcomayo and Bermejo, and the endorrheic basins situated in the NW of Argentina (provinces of La Rioja, Catamarca, Salta and Jujuy). An analysis of Table 6 shows that the highest percentage of endemic species for Argentina occurs in the **Misioneran ecoregion** (figure 2).

The **Subandean-Cuyan ecoregion** corresponds almost entirely to the homonymous ichthyiogeographical province.

The **Patagonian ecoregion** corresponds almost entirely to the homonymous ichthyogeographic province, excepting the relatively small area occupied by the Somuncurá plateau, which is an ecoregion in itself.

The **Patagonian** and **Subandean-Cuyan ecoregions** share some significant elements that are unique to the southernmost areas of the Neotropical Region, in addition to those shared with other regions of the Southern Hemisphere.

The **Somuncurá ecoregion** is a unique area distinguished by endemisms such as *Gymnocharacinus bergi* and other vertebrate taxa, and by the presence of Neotropical, Andean and Subantartic lineages within its aquatic entomofauna. These features support the hypothesis of the relictual character of various elements of the aquatic biota of the region.

There is a 'no-records' area situated between 34°-39°S and 62°20'-69°W (figure 1), which corresponds to the "Transition strip" in Bonetto (1994).

This proposal is of necessity provisional and subject to modifications, which will undoubtedly arise when new data contribute to improve the knowledge of less-surveyed areas.

With respect to conservational purposes, we consider that, although all of the proposed ecoregions undergo various kinds of impacts and threats, we may give priority to some of them, taking into account the following elements: intensity of anthropogenic stress, number of endemisms, combination of physical, chemical and biological components that result in unique features in a national scale, phylogenetic history of occurring taxa, etc. Because of this, we consider that some ecoregions, i.e. **Misioneran, Subtropical Potamic Axis, Salado del Sur-Vallimanca, Central Endorrheic, Subandean-Cuyan, Patagonian** and **Somuncurá ecoregions** form a special group where serious, sustainable conservation policies should be applied by State organisms. These activities should be accompanied by vigorous and consequential educational policies, to provide the future generations with an awareness of the ethical, aesthetic, economic and scientific values of biodiversity, abandoning the anthropocentric vision of nature.

FINAL CONSIDERATIONS

We cannot ignore the social and economic value that fish species have for the inhabitants of any country or region; this value may involve different aspects:

- Source of proteins
- Source of therapeutic products.
- Source of regional developments and money income, such as diverse industries, ecotourism and recreational activities.
- Use as indicators of aquatic-borne diseases and for ecosystem quality monitoring.

In addition, fish play an important part in the distribution and abundance of other aquatic

organisms, due to their dominance and their effects in aquatic environments.

The impact of human interventions on this resource has inspired many biologists in their efforts to counteract some of its disruptive effects. Within the field of systematics, López and Schnack (1995) have stated 'aside from this, it's true that when one considers all the levels of biological organization, from the atoms and macromolecules to the biosphere, within the framework of biodiversity, the biological species is the most significant one, not only because it is a real and identifiable biological entity, but also because it is one the most verifiable proofs of the loss of biotic diversity". It's worth mentioning that the species is not just a conceptual problem for systematic research, but in modern times has acquired social value, as it is the most commonly used measure unit for the quantification of biodiversity (Claridge *et al.*, 1997; **In**: Crisci, 1998). To these concepts we may add Stiassny's (1992) statement that systematic studies, with their major components: taxonomy, phylogenetical analysis and biogeography, play a key role in conservation biology. A clear example of this involvement is set by the groups occupying basal phylogenetic positions, which are therefore of considerable evolutionary significance and whose conservation status should receive special precedence, such as the Diplomystidae.

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Table 1. Number and percentage of species per basin in Argentina.

Basin	Spp. Nº	%
Alto Paraná river	217	49,2
Middle and Lower Paraná river	189	42,9
Paraná Delta	164	37,2
Río de la Plata and tributary streams	153	34,7
Uruguay river	133	30,2
Bermejo river	116	26,3
Area of marshlands in Santa Fe	90	20,4
Area of marshlands in Chaco and Formosa	87	19,7
Río Pilcomayo	75	17,0
Río Salí-Dulce	64	14,5
Tributarios del Paraná en Misiones	62	14,1
Lower Paraguay river	60	13,6
Iguazú river	45	10,2
Río Salado- Aº Vallimanca	43	9,8
Pasaje-Juramento-Salado rivers	42	9,5
Tercero-Cuarto-Carcarañá rivers	37	8,4
Pampean basins of Atlantic drainage	26	5,9
Primero river	21	4,8
Segundo river	20	4,5
SW Pampean basins	17	3,9
Tributaries of Uruguay river in Misiones	15	3,4
Colorado river	13	2,9
Negro river	12	2,7
Rivers in NW of Córdoba province	11	2,5
Tributaries to Pipanaco saltflats (Catamarca)	11	2,5
Mendoza river	9	2,0
Chubut-Senguerr-Chico rivers	9	2,0

Basin	Spp. Nº	%
Desaguadero collector river	8	1,8
Tunuyán river	6	1,4
Watercourses in Tierra del Fuego	5	1,1
Chico-Santa Cruz rivers	5	1,1
Quinto river	5	1,1
Tributaries to Llancanelo lagoon	4	0,9
Deseado river	4	0,9
del Valle-Dorado rivers	3	0,7
Abaucán river	3	0,7
San Juan river	3	0,7
del Valle river and streams from Ambato E slope (Catamarca)	3	0,7
Watercourses in Malvinas islands	3	0,7
NW Pampean basins	3	0,7
Tributaries to Chilecito valley or Santa Elena lowlands (La Rioja)	2	0,5
Jáchal river	2	0,5
Itiyuro river	2	0,5
Chorrillos river	2	0,5
Atuel river	2	0,5
Punan watercourses	1	0,2
Streams in Somuncurá plateau (Río Negro)	1	0,2
Gallegos-Chico del Sud rivers	1	0,2
Diamante river	1	0,2
Coyle river	1	0,2
Bermejo river (La Rioja)	1	0,2
Watercourses in de los Estados Island	1	0,2
TOTAL spp. = 441		

Table 2. Fish families present in each basin in Argentina.

Order	Myliobatiformes	Lepidosireniformes	Clupeiformes			Osmeriformes	Characiformes														Gymnotiformes					Siluriformes																		Beloniformes	Cyprinodontiformes			Atheriniformes	Synbranchiformes	Perciformes			Mugiliformes	Pleuronectiformes	TOTALES
Basin / Family	Potamotrygonidae	Lepidosirenidae	Clupeidae	Pristigasteridae	Engraulidae	Galaxiidae	Characidae	Hemiodontidae	Parodontidae	Cynodontidae	Acestrorhynchidae	Serrasalmidae	Gasteropelecidae	Erythrinidae	Ctenolucidae	Lebiasinidae	Anostomidae	Prochilodontidae	Curimatidae	Crenuchidae	Gymnotidae	Rhamphichthyidae	Hypopomidae	Apteronotidae	Sternopygidae	Diplomystidae	Ariidae	Doradidae	Auchenipteridae	Aspredinidae	Pimelodidae	Heptapteridae	Ageneiosidae	Hypophthalmidae	Cetopsidae	Trichomycteridae	Callichthyidae	Loricariidae	Belonidae	Rivulidae	Anablepidae	Poeciliidae	Atherinopsidae	Synbranchidae	Percichthyidae	Sciaenidae	Cichlidae	Mugilidae	Achiridae	
Lower Paraguay river		V					V	V			V	V			V	V	V	V	V		V				V					V		V				V	V		V				V			V			19
Iguazú river							V							V			V	V	V		V			V	V				V		V	V			V	V	V			V				V			V			16
Alto Paraná river	V	V	V	V	V		V	V		V	V	V	V	V		V	V	V	V	V	V	V		V	V			V	V	V	V	V	V	V	V	V	V	V	V				V			V		V	37
Middle and Lower Paraná river	V	V	V	V	V		V	V		V	V	V	V	V		V	V	V	V	V	V	V	V	V	V			V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V		V		V	41
Paraná Delta	V		V	V	V		V	V		V	V	V	V	V			V	V	V	V	V	V	V	V	V			V	V	V	V	V	V		V	V	V		V	V	V	V	V	V		V		V	38
Uruguay river	V		V	V	V		V		V	V	V	V		V			V	V	V	V	V	V		V	V		V	V	V	V	V	V	V		V	V	V		V		V	V	V	V		V		V	36
Río de la Plata	V		V	V	V		V			V	V	V	V	V			V	V	V	V	V	V		V	V		V	V	V	V	V	V	V		V	V	V		V	V	V	V	V	V		V	V	V	38
Pilcomayo river							V		V		V	V	V	V	V	V	V	V	V	V			V		V				V	V					V	V	V		V				V						24
Chaco-Formosa marshlands		V					V	V			V	V		V		V	V	V	V	V			V		V				V	V	V	V			V	V	V		V				V						24
Bermejo river		V					V		V			V	V	V			V	V	V	V	V		V		V				V	V			V		V	V	V		V				V						24
Del Valle-Dorado rivers							V																							V									V										3
Pasaje-Juramento-Salado rivers							V		V			V		V			V	V		V							V			V	V			V	V	V	V			V	V			V						18
Santa Fe marshlands	V		V	V			V				V	V	V	V		V	V	V	V	V	V		V		V			V	V	V						V	V		V				V		V	V		V	26
Tributaries of Paraná river in Misiones							V		V					V			V	V	V	V	V				V					V					V	V	V				V				V		V	V			19
Tributaries of Uruguay river in Misiones							V																		V						V							V								V				4
Salí-Dulce river							V		V				V		V			V	V	V	V				V				V		V	V				V	V	V			V	V			V						19
Primero river							V		V						V																V	V				V	V	V			V				V						11
Segundo river							V		V						V																V	V				V	V				V	V			V						11
Tercero-Cuarto-Carcarañá rivers							V		V					V	V			V	V	V									V		V	V				V	V	V			V	V			V						17
Salado del Sur-Vallimanca creek			V	V			V				V	V			V			V	V	V	V								V		V	V	V				V	V			V	V			V		V	V			23
Pampean basins of Atlantic drainage			V		V		V								V					V											V						V				V				V		V	V			15
NW Pampean basins							V																								V							V	V	V	V									6
SW Pampean basins							V								V					V											V						V		V	V			V	V	V	V					12
Itiyuro river																				V											V																				2
Puna watercourses																																			V																1
Trib. to Pipanaco saltflats							V																								V				V				V	V									5

Tabla 2. Continued

Order	Myliobatiformes	Lepidosireniformes	Clupeiformes			Osmeriformes	Characiformes														Gymnotiformes					Siluriformes															Beloniformes		Cyprinodontiforme		Atheriniformes	Synbranchiformes	Perciformes			Mugiliformes	Pleuronectiformes	TOTALES
Basin / Family	Potamotrygonidae	Lepidosirenidae	Clupeidae	Pristigasteridae	Engraulidae	Galaxiidae	Characidae	Hemiodontidae	Parodontidae	Cynodontidae	Acestrorhynchidae	Serrasalmidae	Gasteropelecidae	Erythrinidae	Ctenolucidae	Lebiasinidae	Anostomidae	Prochilodontidae	Curimatidae	Crenuchidae	Gymnotidae	Rhamphichthyidae	Hypopomidae	Apteronotidae	Sternopygidae	Diplomystidae	Ariidae	Doradidae	Auchenipteridae	Aspredinidae	Pimelodidae	Heptapteridae	Ageneiosidae	Hypophthalmidae	Cetopsidae	Trichomycteridae	Callichthyidae	Loricariidae	Belonidae	Rivulidae	Anablepidae	Poeciliidae	Atherinopsidae	Synbranchidae	Percichthyidae	Sciaenidae	Cichlidae	Mugilidae	Achiridae	
Abaucán river																																			V															1
del Valle river and Ambato E slope streams (Catamarca)																														V				V		V			V									4
Trib. to Chilecito valley-Santa Elena lowlands (La Rioja)																																		V															1
Chorrillos river (San Luis)																																		V							V								2
Quinto river							V																							V				V					V									4
Rivers of NW of Córdoba province							V																											V					V		V				V				5
Bermejo river (La Rioja)																																		V															1
Jáchal river																																		V					V		V								3
San Juan river																										V								V					V		V		V							5
Mendoza river							V																			V								V					V		V	V		V					7
Tunuyán river							V																			V								V					V		V			V					6
Diamante river																																		V															1
Atuel river							V																											V										V					3
Desaguadero collector river							V																											V					V		V	V	V						7
Tributaries to Llancanelo lagoon																										V								V								V							3
Colorado river							V																			V								V					V		V	V		V			V		8
Negro river						V																				V								V					V		V	V		V					7
Chubut-Senguerr-Chico rivers						V																				V								V					V			V		V					6
Deseado river						V																												V								V		V					4
Chico-Santa Cruz rivers						V																																				V		V					3
Coyle river						V																																											1
Gallegos-Chico del Sud rivers						V																																											1
Watercourses in Tierra del Fuego						V																																											1
Watercourses in de los Estados island						V																																											1
Watercourses in Malvinas islands						V																																											1
Watercourses in Somuncurá plateau (Río Negro)							V																																										1

Table 3. Exotic species present in Argentina. V: confirmed occurrence; d: stable populations are unknown; ?: no records posterior to introduction.

Basin / Species	*Salvelinus fontinalis*	*Salmo trutta*	*Salmo salar*	*Oncorhynchus tshawytscha*	*Oncorhynchus mykiss*	*Hypophthalmichthys molitrix*	*Huro salmoides*	*Gambusia affinis*	*Cyprinus carpio*	*Ctenopharyngodon idellus*	*Carassius auratus*	*Acipenser cf. baeri*
Middle and Lower Paraná river												V
Paraná Delta								V	V			V
Uruguay river									V			
Río de la Plata and tributary streams						V		?	V			V
Salí-Dulce river					d			V	V			
Primero river								V	V			
Segundo river								V	V			
Tercero-Cuarto-Carcarañá rivers					V			V	V			
Salado del Sur river- Vallimanca creek					d				V	V		
NW Pampean basins									V			
SW Pampean basins					d				V			
Pampean basins of Atlantic drainage							?					
Quinto river								V	V			
Rivers of NW of Córdoba province										d	d	
Mendoza river					V				V			
Tunuyán river					V				V			
Desaguadero collector river					V				V		V	
Colorado river		V			V				V			
Negro river	V	V	V		V				V			
Chubut-Senguerr-Chico rivers					V							
Deseado river		V			V							
Chico-Santa Cruz rivers					V							
Yelcho river	V			V	V							
Palena river				V								
Baker river		V			V							
Watercourses in Somuncurá plateau (Río Negro)	V				V							

Table 4. N-S and E-W variation in species richness.

Basin	Species number	References
North - South		
Middle Paraná river	240	del Barco, 1997
Paraná Delta	139	Liotta *et al.*, 1995
Río de la Plata	134	López *et al.*, 1996
Salado basin (Bs. As.)	37	López *et al.*, 2000
East - West		
Middle Paraná	240	del Barco, 1997
Carcarañá river	36	Haro *et al.*, 1998
Salí-Dulce basin	27	Miquelarena *et al.*, 1990 Buti y Miquelarena, 1995
Basins in Catamarca province	18	López *et al.*, 1996 Buti, 1999
Agua Caliente (Jujuy)	16	Menni *et al.*, 1998
Watercourses in San Juan province	5	Arratia *et al.*, 1983 Murua y Acosta (1997)

Table 5. Species cited for the Brazilian sector of Iguazú river that haven´t been recorded Argentina to date.

Species	Author	
Astyanax gymnogenys	Eigenmann, 1911	endemic
Hasemania maxilaris	Ellis, 1911	endemic
Hasemania melanura	Ellis, 1911	endemic
Hyphessobrycon taurocephalus	Ellis, 1911	endemic
Psalidodon gymnodontus	Eigenmann, 1911	endemic genus and species
Glanculocauda melanopleura	Eigenmann, 1911	endemic
Mimagoniates microlepis	Steindachner, 1877	
Heptapterus stewarti	Haseman, 1911	endemic
Rhamdia branneri	Haseman, 1911	endemic
Rhamdia sebae	(Valenciennes, 1840)	
Rhamdia voulezi	Haseman, 1911	endemic
Rhamdiopsis moreirai	Haseman, 1911	endemic
Trichomycterus castroi	Pinna, 1992	endemic
Neoplecostumus sp.		
Jenynsia eigenmanni	(Haseman, 1911)	endemic
Cnesterodon camegiei	Haseman, 1911	endemic
Tilapia rendalli	(Boulenger, 1897)	exotic
Micropterus salmoides	(Lacèpéde, 1802)	exotic

Table 6. Endemic fish species in Argentina.

Order	Family	Species	Author	Basin	Ecoregion
Siluriformes	Diplomystidae	*Diplomystes cuyanus*	Ringuelet, 1965	Desaguadero -Trib.Llancanelo lag.	Subandean-Cuyan
		Diplomystes mesembrinus	Ringuelet, 1982	Chubut-Senguerr-Chico	Patagonian
		Diplomystes viedmensis	McDonagh, 1931	Negro river	Patagonian
	Loricariidae	*Ixinandria steinbachi*	(Regan, 1906)	Bermejo, Pasaje-Juramento-Salado	Subtropical Potamic Axis
		Hypostomus cordovae	(Günther, 1880)	Salí-Hondo-Dulce, Primero, Segundo, Tercero-Cuarto-Carcarañá, NW Córdoba, Bermejo, Pasaje-Juramento-Salado	Central Endorrheic Eastern Paranoplatensean
		Hypostomus laplatae	(Eigenmann, 1907)	Middle Paraná, Paraná Delta, Río de la Plata	Subtropical Potamic Axis
		Loricaria tucumanensis	Isbrücker, 1979	Bermejo basin (San Francisco river); Salí-Dulce	Central Endorrheic Eastern Paranoplatensean
		Loricariichthys edentatus	Reis & Pereira, 2000	Uruguay river	Lower Uruguay River
		Rineloricaria catamarcensis	(Berg, 1895)	Streams of Ambato Eastern slope (Catamarca)	Western Paranoplatensean
	Trichomycteridae	*Silvinichthys mendozensis*	Arratia *et al.* , 1978	Mendoza river basin (Blanco creek), tributaries to Llancanelo lag.	Subandean-Cuyan
		Trichomycterus alterus	Marini, Nichols & La Monte, 1933	Bermejo, Salí-Hondo-Dulce, Abaucán, trib. to Pipanaco salflats, Ambato Eastern slope (Cat.), trib. to Chilecito valley (La Rioja)	Western Paranoplatensean Subandean-Cuyan Central Endorrheic
		Trichomycterus catamarcencis	Fernández & Vari, 2000	Trib. Pipanaco saltflats (Cat.)	Western Paranoplatensean
		Trichomycterus heterodontum	(Eigenmann, 1918)	Bermejo (La Rioja), Mendoza, Desaguadero collector, Colorado rivers	Subandean-Cuyan
		Trichomycterus ramosus	Fernández, 2000	Trib. Pipanaco saltpans (Cat.)	Western Paranoplatensean
		Trichomycterus riojanum	(Berg, 1897)	No exact location	Subandean-Cuyan
		Trichomycterus roigi	Arratia & Menu Marque, 1984	Pilcomayo river; Puna watercourses	Western Paranoplatensean
		Trichomycterus tenuis	Weyenbergh, 1979	NW Córdoba watercourses, Primero, Tercero-Cuarto-Carcarañá, Chorrillos, Quinto	Central Endorrheic Eastern Paranoplatensean
	Heptapteridae	*Rhamdella aymarae*	Miquelarena & Menni, 1999	Itiyuro river	Eastern Paranoplatensean
		Rhamdella jenynsi	(Günther, 1864)	Río de La Plata; Paraná Delta	Subtropical Potamic Axis
	Pimelodidae	*Pimelodus absconditus*	Azpelicueta 1995	Alto Paraná river	Misioneran
		Pimelodus mysteriosus	Azpelicueta 1998	Alto Paraná river	Misioneran
	Doradidae	*Parapterodoras paranensis*	de Risso & Morra 1964	Middle and Lower Paraná river	Subtropical Potamic Axis

Table 6 - Continued

Order	Family	Species	Author	Basin	Ecoregion
Characiformes	Characidae	*Astyanax cordovae*	(Günther, 1880)	Primero and Segundo rivers	Central Endorrheic
		Astyanax ojiara	Azpelicueta & García, 2000	Trib. of Uruguay river in Misiones	Misioneran
		Bryconamericus agna	Azpelicueta & Almirón, 2001	Trib of Paraná river in Misiones	Misioneran
		Bryconamericus eigenmanni	(Evermann & Kendall, 1906)	Primero, Salí-Dulce rivers	Central Endorrheic
		Bryconamericus sylvicola	Braga, 1999	Trib. of Paraná river in Misiones	Misioneran
		Gymnocharacinus bergi	Steindachner 1903	Valcheta creek (Somuncurá plateau, Río Negro)	Somuncurá
		Hyphessobrycon wajat	Almirón & Casciotta, 1999	Middle and Lower Paraná river, marshlands in Chaco and Formosa	Subtropical Potamic Axis
		Oligosarcus menezesi	Miquelarena & Protogino, 1996	Trib. of Paraná river in Misiones	Misioneran
Cyprinodontiformes	Poeciliidae	*Phallotorynus victoriae*	Oliveros, 1983	Middle Paraná river	Subtropical Potamic Axis
	Rivulidae	*Austrolebias nonoiuliensis*	(Taberner, Fernández Santos & Castelli, 1974)	Salado river-Vallimanca creek, NW Pampean basins	Salado-Vallimanca
		Megalebias elongatus	(Steindachner, 1881)	Río de la Plata, Salado river-Vallimanca, Pampean basins of Atlantic drainage atlántica	Subtropical Potamic Axis Salado-Vallimanca
	Anablepidae	*Jenynsia maculata*	Regan, 1906	Pasaje-Juramento-Salado rivers	Eastern Paranoplatensean
		Jenynsia pygogramma	Boulenger, 1902	NW Córdoba rivers, Jáchal, trib. to Pipanaco saltpan	Central Endorrheic Subandean-Cuyan Western Paranoplatensean
Perciformes	Cichlidae	*"Cichlasoma" tembe*	Casciotta, Gómez & Toresani, 1995	Trib to Paraná in Misiones, trib to Uruguay in Misiones	Misioneran
		Gymnogeophagus che	Casciotta, Gómez & Toresani, 2000	Trib. to Paraná in Misiones	Misioneran
	Percichthyidae	*Percichthys altispinnis*	Regan, 1905	Colorado and Negro rivers	Patagonian
		Percichthys colhuapiensis	McDonagh, 1955	Colorado, Negro, Chubut-Senguerr-Chico rivers	Patagonian
		Percichthys vinciguerrai	Perugia, 1891	Colorado, Negro, Chico-Santa Cruz rivers	Patagonian

Table 7. Fish species from mixohaline environments in Argentina. **D**: doubtful occurrence; **F**: frequent occurrence; **O**: occasional occurrence; **P**: present (no frequency data).

Order	Family	Species	Río de La Plata	Mar Chiquita coastal lagoon	Samborombón bay	Bahía Blanca	Colorado river	Gallegos river estuary	Deseado river	Beagle Channel
Chimaeriformes	Callorhynchidae	*Callorhinchus callorhynchus*	O							
Carcharhiniformes	Carcharhinidae	*Sphyrna tudes*	O							
		Sphyrna zygaena	O							
	Triakidae	*Carcharias plumbeus*	O							
		Galeorhinus galeus	O			O				
		Mustelus canis	P							
		Mustelus fasciatus	F							
		Mustelus schmitti	F	P		F				
Lamniformes	Odontaspididae	*Eugomphodus taurus*	F							
Hexanchiformes	Hexanchidae	*Notorhynchus cepedianus*	F					P		
		Notorhynchus pectorosus				O				
Squaliformes	Squalidae	*Squalus acanthias*	O					P		
Squatiniformes	Squatinidae	*Squatina argentina*	O			F				
Rajiformes	Rhinobatidae	*Rhinobatos horkelii*	F							
		Zapteryx brevirostris	P							
	Rajidae	*Atlantoraja castelnaui*	F							
		Atlantoraja cyclophora	F							
		Atlantoraja platana	F							
		Psammobatis extenta	P							
		Psammobatis microps	F							
		Raja agassizi	F							
		Dipturus trachydermus								P
		Sympterygia acuta	F			F				
		Sympterygia bonapartei	F			F				
Torpediniformes	Narcinidae	*Discopyge tschudii*	P							
Myliobatiformes	Dasyatidae	*Dasyatis pastinaca*	O							
	Myliobatidae	*Myliobatis freiminvillei*	F							
		Myliobatis goodei	F		P	F				
Anguilliformes	Congridae	*Bassanago albescens*	O							
		Conger orbingyanus	F		P	O				

Table 7 (Continued)

Order	Family	Species	Río de La Plata	Mar Chiquita coastal lagoon	Samborombón bay	Bahía Blanca	Colorado river	Gallegos river estuary	Deseado river	Beagle Channel
Clupeiformes	Clupeidae	*Brevoortia aurea*	F	P	P	F				
		Platanichthys platana	F	P						
		Ramnogaster arcuata	F	P	D	F				
		Sprattus fueguensis						P		
	Engraulidae	*Anchoa hepsetus*	F							
		Anchoa marinii	F	P	P					
		Engraulis anchoita	O		P					
		Lycengraulis grossidens	F		P	F				
Cypriniformes	Cyprinidae	*Cyprinus carpio*	F		P					
Characiformes	Characidae	*Astyanax eigenmanniorum*		P						
		Bryconamericus iheringi		P						
		Cheirodon interruptus		P						
		Hyphessobrycon anisitsi		P						
		Oligosarcus jenynsi		P						
		Rhaphiodon vulpinus	O							
Siluriformes	Ariidae	*Netuma barba*	P					P		
	Auchenipteridae	*Trachelyopterus sp*	P							
	Heptapteridae	*Pimelodella laticeps*		P	P					
		Rhamdia quelen		P						
	Pimelodidae	*Megalonema argentina*	P							
		Parapimelodus valenciennis	P		P					
		Pimelodus clarias			P					
		Pimelodus albicans			P					
Gymnotiformes	Sternopygidae	*Eigenmannia virescens*	P							
Osmeriformes	Galaxiidae	*Aplochiton taeniatus*								P
		Galaxias maculatus								P
Gadiformes	Moridae	*Salilota australis*						P		P
	Macruronidae	*Macruronus magallanicus*								P
	Merluccidae	*Merluccius hubbsi*						P		
	Ophididae	*Genypterus blacodes*						P		P
	Phycidae	*Urophycis brasiliensis*	O		P					
		Urophycis cirratus	F							

Table 7 (Continued)

Order	Family	Species	Río de La Plata	Mar Chiquita coastal lagoon	Samborombón bay	Bahía Blanca	Colorado river	Gallegos river estuary	Deseado river	Canal del Beagle
Batrachoidiformes	Batrachoididae	*Porichthys porosissimus*	F			F				
		Thalassophryne montevidensis	F							
Mugiliformes	Mugilidae	*Mugil cephalus*	F							
		Mugil liza		P	P	O	F			
Atheriniformes	Atherinopsidae	*Odontesthes argentinensis*	F	P	P	F	O			
		Odontesthes incisa	F	P	P					
		Odontesthes nigricans						P		P
		Odontesthes platensis	F							
		Odontesthes smitti						P		
Beloniformes	Hemirhamphidae	*Hyporhamphus unifasciatus*	F							
Cyprinodontiformes	Anablepidae	*Jenynsia multidentata*	F	P						
	Poecilidae	*Cnesterodon decemmaculatus*		P						
Gasterosteiformes	Syngnathidae	*Syngnathus folletti*	F							
Scorpaeniformes	Triglidae	*Prionotus punctatus*	O							
		Prionotus nudigula	O		P					
	Dactylopteridae	*Dactylopterus volitans*	O							
Perciformes	Carangidae	*Caranx hyppos*	O							
		Hemicaranx amblirhynchus	O							
		Oligoplites saliens	O							
		Oligoplites saurus	O							
		Parona signata	O		P	F		P		
		Selene setapinnis	O							
		Selene vomer	O							
		Trachinotus carolinus		P						
		Trachinotus glaucus	O							
		Trachurus lathami	O							
		Trachurus picturatus australis	P							
	Lobotidae	*Lobotes surinamensis*	O							
	Gerridae	*Eucinostomus gula*	O							
	Pomadasyidae	*Boridia grossidens*	O							
	Zoarcidae	*Austrolycus depressiceps*								P

Table 7 (Continued)

Order	Family	Species	Río de La Plata	Mar Chiquita coastal lagoon	Samborombón bay	Bahía Blanca	Colorado river	Gallegos river estuary	Deseado river	Beagle Channel
Perciformes	Sciaenidae	*Cynoscyon guatucupa*	F	P	P	F				
		Macrodon ancylodon	F		P	O				
		Menticirrhus americanus	F	P	P	O				
		Micropogon opercularis		P						
		Micropogonias furnieri	F	P	P	F				
		Ophioscion adustus	F							
		Pachypops furcraeus	O							
		Paralonchurus brasiliensis	F							
		Pogonias chromis	F	P	P	O				
		Umbrina canosai	F	P	P	O				
	Polynemidae	*Polynemus virginicus*	O							
	Stromateidae	*Acanthistius brasilianus*	O		P	O				
		Peprilus paru	F		P					
		Stromateus brasiliensis	F		P	O				
	Serranidae	*Diplectrum radiale*	O	P						
		Dules auriga	O	P		O				
		Serranus baldwini	O							
		Serranus flaviventris	O							
		Epinephelus marginatus	O							
	Pomatomidae	*Pomatomus saltatrix*	O	P	P	O				
	Sparidae	*Pagrus pagrus*	O							
	Pomadasyidae	*Diplodus argenteus*	F							
	Mullidae	*Mullus argentinus*	O							
	Percophiidae	*Percophis brasiliensis*	O			O				
	Cichlidae	*"Cichlasoma" facetum*		P						
	Uranoscopidae	*Astroscopus sexpinosus*	O							
	Blenniidae	*Hypleurochylus fissicornis*	F							
	Gobiidae	*Gobiosoma parri*	F	P						
	Bovichthyidae	*Cottoperca gobio*						P		P
	Trichiuridae	*Trichiurus lepturus*	F							
	Scombridae	*Scomber japonicus marplatensis*	P							

Table 7 (Continued)

Order	Family	Species	Río de La Plata	Mar Chiquita coastal lagoon	Samborombón bay	Bahía Blanca	Colorado river	Gallegos river estuary	Deseado river	Beagle Channel
Perciformes	Notothenidae	*Eleginops maclovinus*						P	P	P
		Harpagifer bispinnis								P
		Patagonotothen ramsayi								P
		Patagonotothen sima								P
Pleuronectiformes	Pleuronectidae	*Oncopterus darwinii*	F	P		O				
	Soleidae	*Symphurus jenynsii*	F			O				
		Symphurus plagiusa	F		P					
	Paralichthyidae	*Paralichthys brasiliensis*		P	P		D			
		Paralichthys orbignyana	F	P						
		Paralichthys patagonicus				O				
	Bothidae	*Etropus longimanus*	F							
	Cynoglossidae	*Symphurus jenynsi*		P						
Tetraodontiformes	Balistidae	*Balistes capriscus*	O							
	Tetraodontidae	*Lagocephalus laevigatus*	O							

Figure 1. Map of Ichthyogeographic Ecoregions of Argentina

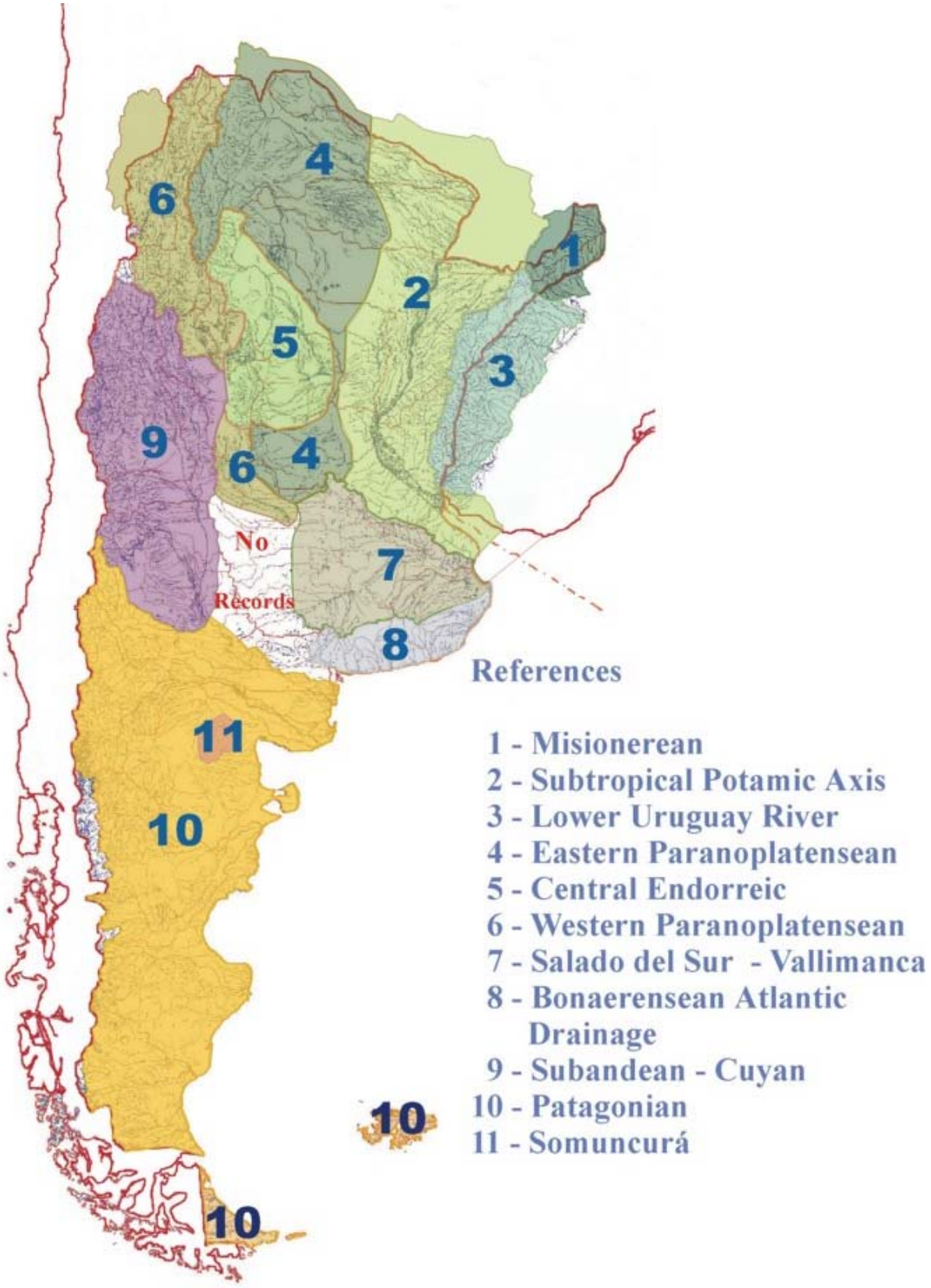
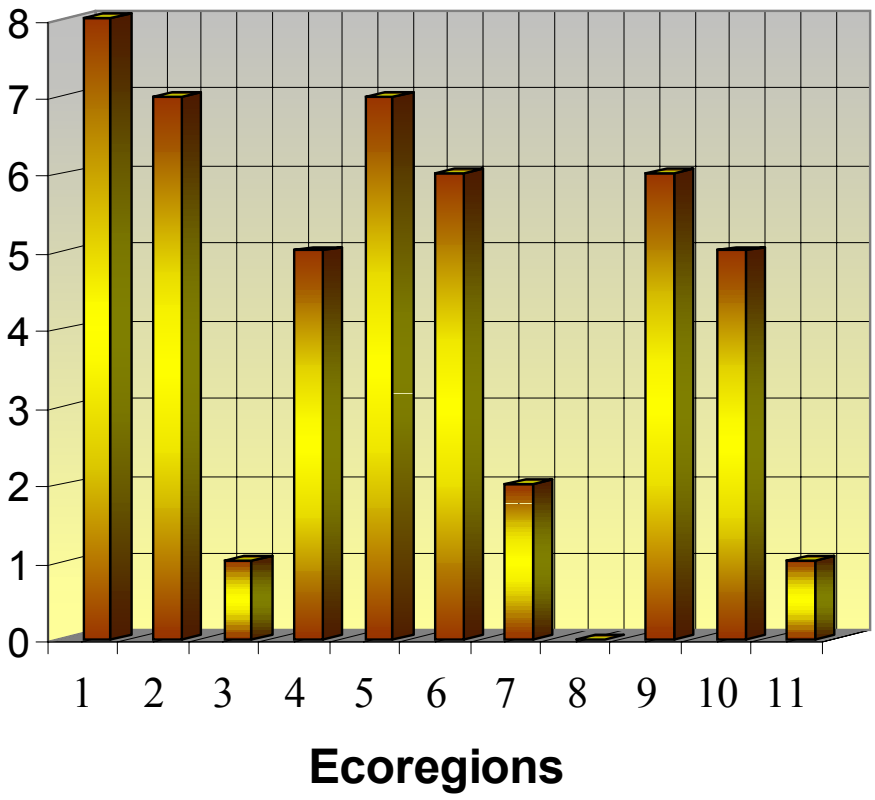


Figure 2. Number of endemisms for each Argentinian ecoregion.



1) **MISIONERAN**
2) **SUBTROPICAL POTAMIC AXIS**
3) **LOWER URUGUAY RIVER**
4) **EASTERN PARANOPLATENSEAN**
5) **CENTRAL ENDORRHEIC**
6) **WESTERN PARANOPLATENSEAN**
7) **SALADO DEL SUR-VALLIMANCA**
8) **BONAERENSEAN ATLANTIC DRAINAGE**
9) **SUBANDEAN-CUYAN**
10) **PATAGONIAN**
11) **SOMUNCURÁ**